THE DISTRIBUTION OF /S/ IN BLACKFOOT:

AN OPTIMALITY THEORY ACCOUNT

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The Distribution of /s/ in Blackfoot: an Optimality Theory Account

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In this thesis I propose that the distribution of /s/ in Blackfoot can be explained by positing that /s/ is inherently moraic in Blackfoot, and explore this hypothesis via two proposals about moraic /s/. The first is that /s/ in complex onsets, e.g., *stsiki*, 'another', is extrasyllabic, and that a moraic /s/ reduces the markedness of these extrasyllabic segments. The second is that because /s/ is moraic, it can act as a syllable nucleus, which explains why the distribution of geminate /ss/ is more similar to long vowels than to geminate consonants. In Blackfoot, clusters of more than two consonants occur only with /s/, and clusters of more than three consonants occur only with geminate /ss/. The Blackfoot syllable seems to be overwhelmingly simple, with /ss/ clusters being the only outliers. While all other geminates occur between vowels, geminate /ss/ often occurs before, after, or between other consonants. This thesis aims to make three specific contributions: (i) to describe the distribution of /s/ in Blackfoot, (ii) to propose that a non-vocoid may be inherently moraic, and (iii) to introduce the PROSODICSEQUENCING constraint, which explains the tendency for onsets to be non-moraic, and predicts that light CVC syllables will be less marked than heavy CVC syllables.

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CHAPTER 1: INTRODUCTION

1.1 Introduction

In this thesis I propose that the distribution of /s/ in Blackfoot can be explained by positing that /s/ is inherently moraic in Blackfoot. I focus specifically on two aspects of moraic /s/. The first is that /s/ in complex onsets, e.g., *stsiki*, 'another', is extrasyllabic, and that a moraic /s/ reduces the markedness of these extrasyllabic segments. The second is that because /s/ is moraic, it can act as a syllable nucleus, which explains why the distribution of geminate /ss/ is more similar to long vowels than to geminate consonants. In Blackfoot, clusters of more than two consonants occur only with /s/, and clusters of more than three consonants occur only with geminate /ss/. The Blackfoot syllable seems to be overwhelmingly simple, with /ss/ clusters being the only outliers. While all other geminates occur between vowels, geminate /ss/ often occurs before, after, or between other consonants. Proposing an inherently moraic /s/ in Blackfoot explains this distribution.

This chapter begins with some basic information about the Blackfoot language, including a survey of the geographic and generational dialects in Blackfoot. § 1.3 continues with the methodology used in this study. § 1.4 surveys the phonological inventory of Blackfoot and gives a brief overview of segment distribution and syllable structure. § 1.5 reviews the significance of this thesis for Blackfoot language study and linguistic theory. § 1.6 summarizes the main points presented herein and presents an outline of the thesis.

1.2 Blackfoot language overview

This section gives a basic overview of the Blackfoot language, including general information about the language and its speakers, geographical and generational dialects, and the status of Blackfoot as an endangered language.

1.2.1 Blackfoot speakers and geographical dialects

Blackfoot is an Algonquian language with around 100 speakers in Montana and 5000 in Alberta (Gordon 2005). It is the western-most Algonquian language, and was the first to diverge from Proto-Algonquian, lacking several of the linguistic innovations shared by the other Algonquian languages (Proulx 1989:44). There are four dialects of Blackfoot, three of which are spoken in Canada and one of which is spoken in the United States: Siksiká (Blackfoot), to the southeast of Calgary, AB, Kainai (Blood), spoken in Alberta between Cardston and Lethbridge, Aapátohsipikani (Northern Piegan), to the west of Fort MacLeod, and Aamsskáápipikani (Southern Piegan), in northwestern Montana (Frantz 2007, Frantz & Russell 1995). The main differences between dialects are lexical, but some morphological differences exist, e.g., *na-* as a past tense prefix in Siksiká, as do phonological differences, though these tend to be relatively minor (Frantz 2007).

1.2.2 Generational differences

Besides regional dialectal differences, there is also a distinct difference between Old Blackfoot (also called High Blackfoot), the dialect spoken by many of the older speakers in their seventies and eighties, and New Blackfoot (also called Modern Blackfoot), the dialect spoken by many of the current speakers in their forties through sixties. New Blackfoot is not well

documented, though Bortolin & McLennan (1995), which Kaneko (1999) notes is the first work to discuss 'Old Blackfoot' vs. 'New Blackfoot', surveys some of the phonetic differences between the two dialects. Van der Mark (2003:7) suggests that "it is likely that there is no distinct break between these two varieties, but that they represent two distinct points on a continuum of change within the language." Since this study focuses on material from Frantz & Russell, which exemplifies Old Blackfoot, this contrast can be set aside.

1.2.3 Blackfoot as an endangered language

The issue of theoretical research on endangered languages is a difficult one, since such research sometimes does not contribute anything to the preservation and revitalization of the language being researched. However, when linguists and language communities collaborate on research, data that comes out of such a project can be beneficial to both parties: language communities can use data for language revitalization purposes that benefit the community, and linguists can use data for theoretical analyses that benefit the field of linguistic theory (Miyashita & Crow Shoe 2009). Hale (1992) illustrates that the loss of linguistic diversity means losing data that can reveal to us the extent of human language variation by pointing out that without the languages of Australia we might think that the pulmonic ingressive or velaric egressive airstreams were impossible usages of the articulatory tract. Blevins (2007) echoes this sentiment, mentioning that it is often only in endangered and under-documented languages that linguists find unique patterns that occur nowhere else, or find evidence that refutes the universality of a theory. Theory-free research is an impossibility, and waiting until a language has been fully documented before beginning theoretical analysis can result in the inability of the researcher to ask valuable questions until it is too late (Bowern 2008). As Himmelmann (2006)

puts it, “language documentation is not a theory-free or anti-theoretical enterprise,” and “without theoretical grounding language documentation is in the danger of producing ‘data graveyards’, i.e., large heaps of data with little or no use to anyone” (Himmelmann 2006:4). Himmelmann (1998) notes that language documentation should include analytic information, and that the difference between documentation and analysis is in the organization and presentation of that information, rather than its presence or absence. This thesis is organized according to the theoretical proposals set forth herein, but I have attempted to include a full range of data from Frantz & Russell (1995) so that this work may be useful even to those who are more interested in the data than the analysis.

It is important to integrate data and structures from understudied languages into current linguistic theory, because these languages can differ in crucial ways from more commonly studied languages. From currently available data, American languages are in many ways different from more commonly studied languages in Europe, Asia, and Africa, and theories that hold for all other languages may not account for languages such as Blackfoot. Because of this, theoretical treatments of indigenous languages of the Americas are valuable in furthering our knowledge of language variation and possible language structures. This thesis attempts to add to the growing theoretical literature on understudied languages in its description and analysis of the distribution of /s/ in Blackfoot.

1.3 Methodology

The data presented in this thesis comes from Frantz & Russell (1995), which is currently the most widely used dictionary of Blackfoot and the only one still in print. I have chosen to use examples given in the dictionary entries as opposed to the bound root headwords. These roots

may not have any actual meaning for the native speaker, and some roots contain initial or final clusters that are never actually tautosyllabic, e.g., *-hkaa*, 'acquire'. Forms are followed by the page number on which they occur in the dictionary. IPA transcriptions given throughout are based on general rules of Blackfoot pronunciation as outlined in Frantz (1991). Because the forms contained in this thesis come from a print source, I have included orthographic representations for every form instead of solely phonetic representations. This is also done as a way of standardization, so that other readers may more easily look up the forms in Frantz & Russell (1995). Blackfoot dialects vary significantly in some respects, and by presenting these generalized dictionary forms and what I intend to be standardized ways of pronouncing them, I hope to make the data more accessible for readers whose only knowledge of Blackfoot is from printed material. There are dangers of using only printed material, viz., misprints, speaker variation, and dialectal differences from underlying forms. The former point I have tried to adjust for by consulting with Dr. Frantz on all the forms used in this thesis, and the latter two I do not believe are relevant for this thesis since my discussion is based on generalized underlying forms, not on differences in pronunciation between forms. Throughout this thesis I have marked syllable boundaries with a period (.) where these boundaries are relevant.

In syllabifying words in this thesis, I have used several general principles. One of these is *minimal onset satisfaction*, which requires syllables to have onsets (Roca & Johnson 1999).[1] This refers to a general preference for onsets over codas. Thus a word such as *mamíí*, 'fish' will be syllabified as *ma.míí*, not *mam.íí*. Another is that codas are preferred to complex onsets, which means that a word such as *miistsís*, 'tree', will be syllabified as *miis.tsís*, rather than *mii.stsís*. Following Hayes (1989), geminate consonants are split between two syllables, as in

[1] While formulations such as "requires" and "must" are used in Optimality Theory as well as rule-based phonology, in OT all constraints are violable, i.e., the ONSET constraint requires syllables to have onsets, but may be violated by an onsetless syllable.

nín.na, 'my father'. This split between two syllables is referred to as *ambisyllabicity*, and is covered in § 2.2.3. (1) gives examples of sample Blackfoot words syllabified using the above principles.

(1) Sample Blackfoot words.

Affricates

a)	áa.**ks**i.ko.ko.to.wa	[áa**kˢ**ikokotowa]	it will be frozen	(117)

Word-medial consonant clusters

b)	stá.mo**h**.**k**a.nook	[stámo̥**χk**ano:k]	convene at a meeting!	(139)
c)	ni.tsíí**s**.**ts**ai'.no.a.wa	[nitˢí:**stˢ**eʔnoaw]	I last saw her	(90)
d)	a**n**.**n**i	[a**n:**i]	that	(102)

Diphthongs

e)	ii.sá.pi.ki.n**ao**'.to.mo.yii.wa	[i:sápikin**ɔ**ʔtomoji:w]	he re-aligned her back	(203)
f)	**áí**'.ta.máa.ksi'.ni.wa	[**é**ʔtamáakˢiʔniw]	he's almost dead	(9)
g)	ní.toh.t**oi**s.ski.maa	[níto̥χt**oi**s:kimą̊]	I herded	(151)

Vowel sequences

h)	ni.tsíí.to.yó'.k**ioo**.ka	[nitˢí:tojóʔkʲ**o:**ka]	he sent me to jail	(178)
i)	k**aa**.**á**h.sa	[k**a:á**χsa]	your grandparent	(255)

Geminate /ss/

j)	o.táí'.n**s**.**s**i	[oté?n**sː**i]	…when he died	(229)
k)	kiáa.ki.t**ss**.ksi.ka.yaa	[kʲáakit**sː**kˢikajaː]	when you recite…	(225)

As in (1a), sequences of /ts/ and /ks/ are syllabified as onsets in Blackfoot, since these sequences are affricates rather than sequences of two separate segments (Frantz 1991; see § 1.5). These are analyzed as affricates rather than segment sequences because: (i) initial Cs- clusters do not exist except ts- and ks-, and (ii) there are phonetic differences in duration between singleton /s/ and affricate /s/ (Don Frantz, p.c.). (1b-d) show example divisions of word-medial consonants. In (1b) and (1c) one consonant is assigned to the coda of the preceding syllable, while the other is assigned to the onset of the following syllable. (1d) shows the syllabification of a geminate consonant, where the segment is assigned to both syllables, as coda to the preceding syllable and onset to the following one. This ambisyllabicity is discussed further in Chapter 2. (1e-g) show the syllabification of diphthongs in Blackfoot. The vowel cluster /ao/, as in (1e), often surfaces as the monophthong [ɔː], which is why I have syllabified (1e) as *.nao'.* rather than *.na.o'.* The same is true for (1f); the sequence /ai/ is usually realized as [eː], so I have represented /áí'/ as a single syllable. (1g) illustrates the sequence /oi/ in Blackfoot, which always represents the diphthong /oi/ except when the sequence is separated by a morphological boundary. In (1h) I have represented the sequence *kioo* as a single syllable, as I have done with all /CiV(V)/ sequences, because the /i/ is usually realized as the nonsyllabic palatal glide [j] rather than as a full vowel. In (1i) I have syllabified the short high tone /a/ as the beginning of a new syllable, since Blackfoot is generally not recognized as having rising tone or tautosyllabic super-long vowels (Frantz 1991, Taylor 1969, Uhlenbeck 1938). (1j-k) introduce the problem of geminate

/ss/ in Blackfoot, which is the subject of this thesis. For reasons detailed in Chapter 3, I have syllabified /s/ in these examples as a syllable nucleus. In (1j) the geminate /ss/ forms the nucleus of the third syllable and the onset of the fourth syllable, while in (1k) the third syllable features /ss/ as a syllable nucleus, with /t/ forming an onset.[2]

1.4 Blackfoot Phonology

This section surveys the phonological inventory of Blackfoot, including the distribution of consonants and vowels, the presence of distinctive segment length, and the presence of contrastive pitch in vowels.

1.4.1 Consonants

Blackfoot has a relatively small consonant inventory compared to many neighboring indigenous languages, e.g., Kutenai or Kalispel, primarily in that it does not employ glottalization or voicing for phonemic contrasts. (2) shows the orthographic representation of consonants in Blackfoot, as well as the corresponding IPA symbols where they differ from the orthography.

[2] Whether this /tss/ sequence should be treated as /ts:/ or /t^{s}s/ is beyond the scope of this thesis, and is not relevant to the syllabification outlined above.

(2) Consonants in Blackfoot.

	Labial	Alveolar	Palatal	Velar	Glottal
Stop	p	t		k	’ [ʔ]
Fricative		s		h [x~χ]	
Nasal	m	n			
Affricate		ts		ks	
Glide	w		y [j]		

All symbols are the orthography developed by Don Frantz in conjunction with Blackfoot community members (Frantz 1978). Most symbols retain standard IPA values, except for the use of /h/ for the velar fricative [x], /y/ for the palatal glide [j], and /’/ for the glottal stop [ʔ]. The stops, /p/, /t/, /k/, and /’/, are all voiceless and unaspirated (Frantz 1991). All stops occur syllable-initially and syllable-finally except /’/, which only occurs syllable-finally with a few exceptions, including *na’á*, a vocative form for ‘mother’ (133) and *sa’áí*, ‘duck’ (206). The nasal stops /m/ and /n/ can appear syllable-initially, though never after /s/, and syllable-finally as the first member of a geminate or before geminate /ss/. /m/ only occurs as a coda word-medially. Blackfoot has two affricates: /ts/ and /ks/. These two affricates can occur syllable-initially or syllable-finally, and have the same distribution in phonology and morphology as other stops. For these and other reasons these affricates are treated as single phonemes (Elfner 2005), not as a stop + fricative series.

/h/ [x] is always preceded by a vowel and followed by a stop, i.e., it only occurs as a coda. One reason for this is that in most cases any consonant occurring before a stop, i.e., in coda position, was leveled to /h/ historically (Proulx 1989). Frantz & Russell (1995) lists only

seven /h/-initial stems, four of which are bound. The three free morphemes are all expressions that are not strictly lexical: *hánnia*, 'expression used in response to a topic of interest', *ha'*, 'expression used to show scorn for someone's showy behavior', and *há'ayaa*, 'expression used mainly by males in anticipation of a reprimand'. In these cases the orthographic /h/ represents a "smooth onset" rather than a fricative (Don Frantz, p.c.). Because they are not lexical items, these entries should be excluded from phonological analysis, much like the dental click of English 'tsk, tsk'. In Blackfoot, /w/ only occurs phonemically in syllable-initial position, though phonetically it often occurs at the end of a word due to reduction of the third person suffix *-(a)wa*. Underlying /y/ always occurs syllable-initially, though underlying /i/ sometimes surfaces as [j] after a consonants and before a vowel, e.g., *kiááyo*, 'bear' [ki.á:.jo] or [kʲá:.jo].

/s/ has a distribution that differs significantly from every other phoneme, and for this reason is the subject of investigation in this thesis. /s/ can occur syllable-initially or -finally. In addition, /s/ is the only phoneme that can occur in complex onsets and one of three (with /h/ and /'/) that can occur in complex codas. Geminate /ss/ occurs word-initially, but I have found no instances of word-final geminate /ss/. Geminate /ss/ can also occur before, after, and between other stops, whereas all other geminates occur only between vowels. It may be relevant for the claims put forth in this thesis regarding the peculiar distribution of /s/ that /s/ is the only fricative that can occur in multiple positions within the syllable, since /h/ can only occur syllable-finally. However, since /s/ has peculiar characteristics in many other languages, including English, Cherokee, and Haida, I take the position that it is /s/, and not fricatives in general, which behaves differently in Blackfoot.

The data in (3) present examples of simple onsets in Blackfoot in word-initial and word-medial position.

(3) Simple onsets in Blackfoot

Word-initial

Stops

a) **p**iih.ks.só	[**p**ixksːó]	nine	(189)
b) **t**a.pi.káíi.mii	[**t**apikáemiː]	cricket	(234)
c) **k**aah.to.máán	[**k**aχtomáːn]	enemy	(112)
d) **m**oo.kí.tsis	[**m**oːkítˢɪs]	toe/finger	(129)
e) **n**ááo	[**n**ɔːo]	be six	(131)

Affricates

f) **ts**a	[**tˢ**a]	how?/what?	(234)
g) **ks**i.só.yi	[**kˢ**isóji]	tea kettle	(119)

/s/

h) **s**a.'áí	[**s**aʔáj] ~ [**s**aʔæː]	duck	(206)

Word-medial

Stops

i) oh.**p**oos	[ox**p**oːs]	cat	(148)
j) po.no.káó.mi.**t**aa	[ponokɔ́ːmi**t**aː]	horse	(192)
k) ooh.**k**ó.yi.maa'.tsis	[ox**k**ójimaːʔtˢɪs]	lid	(168)
l) o.**m**a	[ó**m**a]	that	(157)
m) ksii.**n**i	[kˢiː**n**i]	cowbird	(118)

Affricates

n) tá.**ts**i.ki	[tá**t**ˢiki̥]	middle	(234)

o) o.**ks**is.stsi	[o**kˢ**ɪsːtˢi̥]	his mother	(51)

/s/

p) a.móí.pii.**s**aa.wa	[amójpi**s**aːw]	gather them!	(164)

Glides

q) ni.tá.**w**aa.sai'.ni	[nitá**w**aːseʔni]	I am crying	(246)
r) pá.**y**o.is.tsi	[pá**j**oistˢ]	scars	(188)

As shown above, the typical simple onset consists of a stop, affricate, or /s/ word-initially. /w/ and /y/ can form word-medial onsets but are never found word-initially. Complex onsets, as mentioned before, always involve /s/. (4) shows complex onsets in Blackfoot.

(4) Complex onsets in Blackfoot

Word-initial

a) **sk**iim	[**sk**iːm]	female animal	(214)
b) **sksks**in.ni	[**skˢkˢ**ɪnːi]	crack	(214)
c) **sp**á.tsi.ko	[**sp**átˢiko]	sand	(220)
d) **st**á.mi.ta.poot	[**st**ámitapoːt]	just go there!	(232)
e) **sts**í.ki	[**stˢ**íki̥]	another	(232)

Word-medial

f) is.**sp**ay.ss.too	[ɪs**sp**ajʔsːtoː]	mule deer	(87)
g) ksis.**st**o.ním.maa.pio.yiis.tsi	[kˢɪs**st**oním:aːpʲojistˢ]	sheds	(120)
h) ní.toh.tois.**sk**i.maa	[níto̥χtojs**sk**imą̊]	I herded	(151)

i) áa.ksis.**sks**aa.na'.pii.wa [áakˢɪs**sk**ˢaːnaʔpiːw] it will settle (267)

As seen in (4), complex onsets always involve /s/, a pattern that is paralleled somewhat by English, which only allows triconsonantal onsets if the first segment is /s/.[3] The second segment is always a stop or affricate. Word-medial complex onsets always begin with the second member of a geminate /ss/, since otherwise intervocalic consonant clusters are always separated into a coda and an onset.

Codas, when simple, may consist of any consonant except /w/ and /y/[4]. The data in (5) show several constraints on word-final codas in Blackfoot.

(5) Simple codas in Blackfoot.

Word-medial

Stops

a) i**p**.po.tsi.pis.taan	[ɪ**p**potˢipistaːn]	braid	(80)
b) no**t**.to.ksíí.ksi	[no**t**tokˢíːkˢi̥]	my knees	(130)
c) i**k**.kss.píí.sa	[ɪ**k**ksːpíːsḁ]	hit him!	(45)
d) ni.tá.waa.sai**'**.ni	[nitáwaːse**ʔ**ni]	I am crying	(246)
e) i.tsi.ksí.na**m**.ma	[itˢikˢína**m**mḁ]	he is weak	(101)
f) ni**n**.na	[ní**n**nḁ]	my father	(61)

[3] English triconsonantal onsets also parallel Blackfoot complex onsets in that triconsonantal onsets in English always violate sonority sequencing, since they always have /s/ as the first member and a stop as the second member. Sonority sequencing is discussed in § 3.2.2.2.

[4] /w/ often ends up as a coda because of final vowel deletion, e.g., the suffix *-w(a)* (Frantz 1991). The same is true for word-final /s/: it does not occur in underlying forms, but often does in surface forms, e.g., because of final vowel deletion. /y/ occasionally occurs as a word-medial coda before geminate /ss/, though in these cases it is typically followed by an epenthetic glottal stop.

Affricates

g) aa.po**ts**.ki.na	[aːpo**tˢ**kiną]	cow	(4)
h) ó.mah.ksí**ks**.ko.is.tsi	[ómąχkˢí**kˢ**koistˢ]	tall trees	(160)

Fricatives

i) mii**s**.tsí**s**	[mi**ːs**tsís]	tree	(126)
j) is.spi**h**.ki.ma	[ɪsːpi̥**x**kimą̊]	he slacked off	(227)

Word-final

k) sáóh.pa.po.kai'.ss.too**t**	[sɔ́χpapokeʔsːto**ːt**]	air it outside!	(200)
l) stá.moh.ka.noo**k**	[stámo̥χkanoː**k**]	listen to me!	(139)
m) ni.tsín.ni.si'.yih.pin.naa**n**	[nitˢínːisiʔjixpɪnːaː**n**]	we (excl.) fell	(63)[5]

/p/ does not seem to occur in word-final position in simple codas, though it does appear in complex input codas and simple output codas where the initial member /'/ or /h/ has been deleted. There is no clear reason for this, but I have thus far never come across a word that ends in a -Vp sequence. This may be an accidental gap, or it may reflect a constraint on word-final codas in Blackfoot. Likewise, /m/ often shows up root-finally, as well as word-finally because of final vowel deletion, but I have yet to find an example of a fully inflected form with underlying final /m/. /'/ and /h/ also never show up in word-final codas. In all but a very few cases, these phonemes are only found pre-consonantally. As mentioned above, one reason for this is that codas were generally leveled to /h/ in Blackfoot (Proulx 2005:6). /n/ does occur word-finally, but word-medially is generally found as a coda only in the case of extra length, as is /m/. One exception to this is occurrences before geminate /ss/; while further study is necessary, it seems

[5] excl. = exclusive

most useful to posit that in /Nss/[6] sequences the nasal should be parsed as the coda of the preceding syllable. /ts/ and /ks/ never seem to occur word-finally as simple codas. Again, it is unclear whether these are accidental gaps or reflect some constraint on Blackfoot phonotactics.

(6) gives examples of complex codas in Blackfoot.

(6) Complex codas in Blackfoot.

a) an.níí**hk**	[anːí**xk**]	before	(11)
b) ó.mah.kí.nai**'ks**.kim.mi.ksi	[ómaᵊχkíne**ʔkˢ**kɪmːikˢ]	pension	(159)
c) i**st**.toh.kaii.pis.stsi	[ɪ**st**toᵊχkejpɪsːtˢ]	fabric	(91)
d) skai'.ká.ka.not.tsii.yii**sts**.ko.wa	[skeʔkákanottˢiːjiː**stˢ**kowa]	trees are sparse	(113)

Complex codas always have /'/, /h/, or /s/ as their first member, and a stop or affricate as their second member.[7] There are no complex codas involving nasals. Since there are also no complex onsets involving nasals, I take this to be a proscription of complex syllable margins involving nasals in Blackfoot. It is not clear whether the other gaps in the data above, viz., the non-occurrence of -sp, -sk, -sks, -'t, and -'k, are disallowed by the language or simply occur so rarely that examples are difficult to find.

Since consonant length is phonemic in Blackfoot, minimal pairs do exist, as shown in (7), though often this is at the root level.

(7) Consonant length minimal pairs.

a) kítssi'ka**k**i	you kicked	(213)

[6] I use N throughout to represent any nasal, i.e., /n/ or /m/, rather than a placeless archiphoneme.
[7] /'p/ and /hp/ do not seem to occur in input forms, but are found not uncommonly in output forms because of final vowel deletion.

b) kítssi'ka**kk**i	you kicked me	(213)
c) áaksiksi**m**inihkatsiiwáyi	she will call him by a pet name	(50)
d) áaksiksi**mm**inihkatsiiwáyi	she will refer to him jokingly	(50)
e) áaksi**n**ima	he will see it	(63)
f) áaksi**nn**ima	he will hold it	(266)
g) ki**p**itáaakii	old lady	(116)
h) ki**pp**itááma	your old lady	(79)
i) issi**s**	fat	(85)
j) issi**ss**	younger sibling of a female	(85)
k) áípo**t**awa	he's getting a beating	(78)
l) áípo**tt**aawa	he's flying	(78)
m) itssitsípssa**ts**iiyaawa	they talked with him	(213)
n) itssitsípssa**tts**iiyaawa[8]	they made him talk	(213)
o) si**ks**inááttsi	black	(207)
p) ksi**kks**inááttsi	white	(119)

Because of the heavily polysynthetic nature and complex verbal morphology of Blackfoot, exact minimal pairs at the word level are difficult to come by, as evidenced by the near-minimal pairs in (g-l) and (o-p). Minimal pairs are more common at the root level, but as shown in (a-f), exact minimal pairs at the word level do occur.

[8] Don Frantz (p.c.) notes that he obtained this form during past research, but working more recently with a speaker was unable to get clear acceptance of this token.

1.4.2 Vowels

The vowel system of Blackfoot remains understudied, and is phonetically quite complex. However, Frantz (1991) posits only three phonemic vowels in Blackfoot: /a/, /i/, /o/. (8) shows underlying vowels and diphthongs in Blackfoot as well as their common phonetic realizations, which are not entirely predictable (Elfner 2005, Van der Mark 2003, Frantz & Russell 1995, Frantz 1991), as discussed below.

(8) Vowels in Blackfoot.

/a/	a, ʌ
/i/	i, ɪ, e, j
/o/	o, ʊ, u
/ai/	e, ɛ, aj, ej, æ
/ao/	ɔ, ao, aw
/oi/	ɔj

While other vowels have been treated as phonemic by some authors, for example, Taylor (1969) treats [u] as a phoneme and Van der Mark (2003) treats [ɛ] and [ɔ] as phonemes, there are no minimal pairs contrasting [u] and [o], [e] and [i], etc. [u] and [o] seem to be in free variation (Elfner 2006), while [e], [ɛ], and [ɔ] occur as merged forms of the diphthongs /ai/ and /ao/. [ʌ] is a variant of short /a/, especially before geminates. [i] and [e] seem to be unpredictable variants of /i/, especially [ei] for /i:/, while [ɪ] occurs as the lax version of short /i/ before geminates and in a few common affixes. /i/ becomes the glide [j] when it occurs after a consonant and before a vowel. The difference between [o], [ʊ], and [u] is not entirely predictable and often varies from speaker to speaker and token to token, but there are no minimal pairs or near minimal pairs contrasting these vowels. /ai/ is most often realized as [e], or [ɛ] before geminates, but is pronounced as [ej] when long. The [aj] variant is fairly uncommon. [æ] is a dialectal variant

used on the Blood reserve (Frantz 1991). /ao/ is usually realized as [ɔː], but occasionally as [ao] or [aw]. (9) provides examples of the vowels of Blackfoot.

(9) Vowel nuclei in Blackfoot

a) kaa.**á**h.s**a**	[kaː**á**χsḁ]	your grandparent	(255)
b) iih.ts**i**.maa.wa	[ixtˢ**i**maːw]	he read	(152)
c) p**o**.n**o**.káó.mi.taa.yi	[p**o**n**o**kɔ́ːmitaːji̥]	horse	(77)
d) a.w**áí**s.staam	[aw**é**sːtaːm]	flag	(16)
e) **áó**.ki.nii.mo	[**ɔ́ː**kiniːmo̥]	red cedar	(11)
f) a.w**óí**'.ss.taa.ks.sin	[aw**ój**ʔsːtaːksːin]	cross	(16)

1.4.2.1 Vowel length. All Blackfoot monophthongs, as well as the diphthongs /ai/ and /ao/, can be either long or short. /oi/ is always short. (10) shows minimal pairs for vowel length contrasts in Blackfoot.

(10) Vowel length minimal pairs.

a) áy**aa**moowa	he went in a different direction	(17)
b) áy**a**moowa	he went with hurt feelings	(254)
c) ootsists**íí**ni	strawberry	(169)
d) ootsists**í**ni	palate	(169)
e) áako'k**o**wa	it will be fall	(181)
f) áako'k**oo**wa	she will become exhausted	(182)

1.4.2.2 Contrastive pitch. In addition to length, pitch is also phonemic for Blackfoot vowels. High pitch is marked with an acute accent (´), while low pitch is unmarked. Blackfoot is generally considered to be a pitch accent language, in that it has contrastive pitch, but not a tonal system (Frantz 1991). Syllables are not stressed as they are in English or Spanish; rather, certain syllables are merely higher in pitch.[9] Van der Mark (2003) presents five acoustic correlates of marking syllable prominence: frequency (F_0), amplitude peak, average amplitude, total amplitude, and duration. While stress languages like English utilize all five acoustic correlates in stressed syllables, pitch accent languages such as Japanese use only pitch, and tone languages use a higher F_0 as a phonemically contrastive feature, just as voicing or point of articulation (Van der Mark 2003). Blackfoot uses a higher average amplitude and higher pitch, so Van der Mark concludes that Blackfoot is most easily classified as a pitch accent language. The question arises as to how much acoustics can tell us about stress/accent, which is a very subjective measure. However, Hayes (1995), even as he questions whether phonetics can ever tell us anything valuable about syllable prominence, acknowledges that there are certain acoustic correlates that match up with native speaker intuitions about stress or accent, such as amplitude and fundamental frequency. Thus Van der Mark's analysis supports Frantz (1991) in classifying Blackfoot as a pitch accent language. (11) gives minimal pairs for pitch in Blackfoot.

(11) Pitch accent minimal pairs.

a) aká-	many	(9)
b) áka-	old, belonging to a former time, ancient	(9)
c) ki	connective similar to English 'and'	(114)

[9] Taylor (1969) presents a contrasting view, saying that "the phonemic feature of stress is intensity", and that higher pitch is a nonphonemic feature which accompanies stress. Uhlenbeck (1938) also refers to "stress", but this seems to be simply a terminological vaguery rather than a specific claim about syllable prominence type in Blackfoot.

d) kí	come on, let's go!	(114)
e) ohko-	have the wherewithal for	(141)
f) ohkó	son	(141)

1.5 Significance of the thesis

This thesis aims to make three specific contributions: (i) to describe the distribution of /s/ in Blackfoot, (ii) to propose that a non-vocoid may be inherently moraic, and (iii) to introduce the PROSODICSEQUENCING constraint, which explains the tendency for onsets to be non-moraic, and predicts that light CVC syllables will be less marked than heavy CVC syllables. The first contribution is a descriptive one. While some recent studies have focused on the syllable in Blackfoot (see Elfner 2007, 2006, 2005, Derrick 2007), there has been no publication devoted entirely to an exploration of syllable structure in Blackfoot, and this work is intended to form a part of the descriptive literature on Blackfoot syllable structure. Blackfoot words are usually easy to divide into syllables, with the sole exception of syllables containing /s/, which is why this thesis focuses on this phoneme. This thesis contributes to the descriptive literature on Blackfoot by surveying the distribution of /s/ in comparison to other segments, and presenting this information in a way that aims to be helpful to those studying, learning, and speaking the language. Research of this nature can be valuable because research into syllable structure provides useful rules and constraints regarding pronunciation and morphophonemics.

The second contribution of this thesis is theoretical: the proposal that a non-vocoid segment may be inherently moraic. Vowels are taken to be inherently moraic, but consonants are assumed to be non-moraic (Hayes 1989). However, as detailed in Chapter 3, the proposal that /s/ is inherently moraic in Blackfoot explains several puzzling aspects of its distribution.

The assumption of moraic /s/ also predicts that /s/ should be able to act as a syllable nucleus. Reasons for positing a syllabic /s/ in Blackfoot are considered in § 3.3.

The third contribution is also theoretical: the proposal of a PR(OSODIC)SEQ(UENCING) constraint, within the framework of Optimality Theory. Cross-linguistically, onsets are held to be non-moraic, as evidenced by the fact that while nuclei and codas contribute to syllable weight, onsets do not. In some languages, e.g., Lardil, codas are also weightless, i.e., CVC syllables are counted as light for purposes of stress assignment. The PRSEQ constraint (introduced and described in detail in Chapter 4) offers an explanation for the fact that nuclei are often, or in some languages, e.g., Lardil (Hayes 1989), always, the only moraic position in the syllable, because it states that syllable margins must belong to a lower prosodic category than syllable nuclei. Since all segments must be parsed to the syllable node unless they are extrasyllabic, a syllable that satisfies this constraint would have an onset and coda that attach directly to the syllable node, and a nucleus that is attached to a mora. Thus the syllable node is dominating segments at its margins, while dominating a mora at its center. This constraint predicts that light CVC syllables will be less marked than heavy CVC syllables, and thus that more languages will count CVC syllables as light than as heavy.

1.6 Summary and outline of the thesis

This chapter has reviewed background information on the ideas to be detailed in the remaining chapters. I introduced the main phenomenon this thesis explores: the peculiar distribution of /s/ in Blackfoot. I described the methodology of this study and how I have chosen to syllabify Blackfoot words, including evidence supporting this method of syllabification. I gave a general overview of the Blackfoot language, including a description of the differences

between Old and New Blackfoot, and surveyed Blackfoot phonology, including a brief overview of consonants and vowels in Blackfoot, as well as representative samples of Blackfoot words containing these phonemes. Finally, this chapter outlined the significance of this thesis.

The following chapters propose that the distribution of /s/ in Blackfoot is best explained by positing that /s/ is inherently moraic in Blackfoot. I argue that this proposal accounts both for the ability of /s/ to participate in complex onsets and predicts that /s/ can act as a syllable nucleus. Chapter 2 gives an overview of the theoretical background used in this thesis, specifically Moraic Phonology and Optimality Theory. Chapter 3 considers the problem of /s/ in Blackfoot, which has a very different distribution than most phonemes, and proposes that these fundamental differences can be explained by positing that /s/ is inherently moraic in Blackfoot. Chapter 4 offers an Optimality Theory account of moraic and syllabic /s/ in Blackfoot. Chapter 5 summarizes the claims put forth in the thesis and discusses the implications of these claims, as well as suggesting avenues for future research.

CHAPTER 2: THEORETICAL BACKGROUND

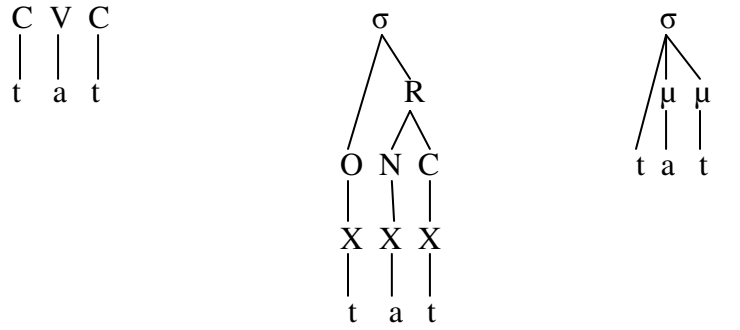
2.1 Introduction

The purpose of this chapter is to introduce the basic concepts behind the primary theoretical frameworks used in this thesis: Moraic Phonology (Hyman 1985, Hayes 1989) and Optimality Theory (Prince & Smolensky 1993, McCarthy & Prince 1993). Moraic theory is used throughout this thesis, and Optimality Theory is used in Chapter 4 to analyze the status of /s/ in Blackfoot, specifically the proposal that /s/ is inherently moraic in Blackfoot. This chapter is intended to lay the groundwork for these later theoretical analyses, and to introduce the reader to how these theories are relevant to Blackfoot and how they can be used to explain phonological processes in Blackfoot.

Phonological theories seek to describe the sound patterns of specific languages, and in some cases, of Language in general. One of the basic units of structure used to group sounds in various languages is the syllable, "a level of organization of the speech sounds of a particular language" (Akmajian et al. 2001). Hayes (1989) summarizes the history of syllable structure representation, from CV theory (McCarthy 1979) to X theory (Levin 1985, Lowenstamm & Kaye 1986), and finally to Moraic Phonology (Hyman 1985, Hayes 1989). Syllable structure representations in these theories are given in (1). (σ = syllable, R = rime, O = onset, C = coda.)

(1) Syllable structure representation.

(a) CV theory (b) X theory (c) Moraic Phonology



In (a), consonants and vowels are given different types of skeletal slots to which to attach. In (b), these different types have been generalized, so that each skeletal slot is simply marked with an X which does not distinguish between consonants and vowels, but merely marks segments. In (c), this type of segmental representation has been discarded, with only the various nodes in the prosodic hierarchy being relevant. This thesis adopts the structural notation of moraic phonology, discussed in detail in the next section.

2.2 Moraic Theory

The basic premise of moraic phonology (Hayes 1989, McCarthy & Prince 1986, Hyman 1985) is that the mora (μ) is responsible for weight distinctions between, e.g., CV syllables on the one hand, and CVV syllables (and CVC in many languages) on the other. Elfner (2006) gives an account of moraic theory applied to Blackfoot, but this is the only study of the mora in Blackfoot. Thus the mora is still an understudied aspect of Blackfoot phonology, with most phonological accounts simply assuming either a syllabic or a moraic analysis. This section outlines the basics of moraic theory as used in this thesis: the prosodic hierarchy and

extrasyllabicity (2.2.1), syllable weight (2.2.2), vowel and consonant length (2.2.3), and Weight-by-Position (2.2.4).

2.2.1 The prosodic hierarchy and extrasyllabicity

Before giving examples of prosodic organization in moraic theory, it is necessary to define the prosodic hierarchy. I follow the prosodic hierarchy outlined in McCarthy & Prince (1993), as shown in (2).

(2) Prosodic hierachy.

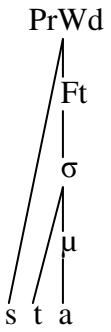
PrWd = prosodic word
|
Ft = foot
|
σ = syllable
|
μ = mora (to be explained in the following section)[10]

As shown in (2), the standard prosodic hierarchy used in this thesis represents the prosodic word dominating the foot, which dominates the syllable, which in turn dominates the mora. The levels of prosodic organization in the hierarchy are responsible for governing the domains of application of various phonological processes. One possible violation of this hierarchy is important for the claim of moraic /s/ outlined in Chapter 3: the case of a segment parsed to a level higher than the mora. This is common for syllable onsets, which are not typically attached to a mora (Hayes 1995, Hayes 1989). Chapter 4 will propose the PROSODICSEQUENCING constraint to explain why this is the case.

[10] A common exception to the hierarchy is the onset position, which is typically held to attach directly to the syllable node, rather than first attaching to a mora. See § 4.2.1.

In some cases, however, a segment may be parsed to a node even higher than the syllable, e.g., the prosodic word. A segment such as this is termed extrasyllabic, and the resulting structure is shown in (3).

(3) Extrasyllabic segments.



In (3), the initial /s/ is extrasyllabic because it is parsed directly to the prosodic word. The /t/, on the other hand, is parsed to the syllable node, and thus is not extrasyllabic. This type of extrasyllabicity may be motivated by any number of factors, especially the avoidance of complex onsets. Two segments only create a complex onset if they are both parsed to the syllable node. Chapter 3 suggests that this type of extrasyllabicity occurs in Blackfoot to eliminate complex onsets at the syllabic level.

2.2.2 Syllable weight

The concept of the mora grew out of the necessity of accounting for the difference between heavy and light syllables in stress assignment. In many languages, stress is attracted to heavy syllables. This tendency is formalized in Prince (1990) as the Weight-to-Stress Principle, which states that if a syllable is heavy, it should be stressed. While Prince (1990) argues against

a corresponding Stress-to-Weight principle, which would prescribe length to stressed syllables, he does note that several languages have processes that superficially seem to have such a principle. Van der Mark (2003) notes that some Blackfoot speakers lengthen short stressed vowels while shortening long unstressed vowels, e.g., *piikáni* → *piikáání*. Prince (1990) attributes such lengthening to a requirement for feet to have two moras rather than a Stress-to-Weight principle. These types of principles are not directly relevant to the distribution of /s/ in Blackfoot, and so will not be discussed in this thesis.

Many of the basic tenets of moraic phonology came out of research into prominence sensitive languages, i.e., languages that have some form of stress. In some languages, it is the case that CVV and CVC syllables are treated as heavy for the purposes of stress assignment, e.g., English and Latin, while in other cases CVC syllables are counted as light, e.g., Lardil. In the latter case it is assumed that the language does not treat coda consonants as moraic, i.e., the language does not have Weight by Position (Hayes 1989). (4) shows examples of light and heavy syllables.

(4) Syllabic structure for light and heavy syllables.

(a) Light V (b) Light CVC (c) Heavy VV (d) Heavy CVC

(4a) shows the syllabic structure for a syllable with a short V, which is counted light in all languages. (4b) shows a light CVC syllable. In languages that count CVC syllables as light, the

coda consonant is not represented as being attached to a mora. (4c) shows a syllable with a long V, which is counted heavy in all languages. (4d) shows a heavy CVC syllable. In languages that count CVC syllables as heavy, the coda consonant is represented as being attached to a mora (Hayes 1989). Since Blackfoot is a prominence-insensitive language, similar to Japanese (see Cole & Miyashita 2006), it may be more useful to treat the heavy/light distinction as a long/short distinction. This is an area which requires more research, and is outside the scope of this thesis.

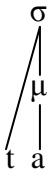
2.2.3 Segment length

This section discusses how vowel and consonant length are represented in moraic theory, and explains the concept of ambisyllabicity as developed in Hayes (1989).

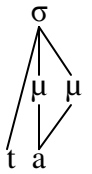
2.2.3.1Vowel length. Moraic phonology has since expanded to be able to explain any number of phenomena related to syllable weight and segment length. Moraic phonology posits that short vowels are associated with a single mora, while long vowels are associated with two moras. (5) shows the difference between a syllable with a short vowel and a syllable with a long vowel.

(5) Syllabic structure for *ta* versus *taa*.

(a) Short vowel



(b) Long vowel

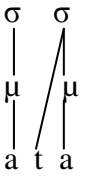


In (5a), /a_{μ}/ surfaces as short [a] because it is attached to a single mora. In (5b), /$a_{\mu\mu}$/ surfaces as long [a:] because it is attached to two moras. By proposing that /s/ is inherently moraic and can act as a syllable nucleus, this thesis proposes as a corollary that /s/ in Blackfoot receives length just as vowels do: short /s/ has one mora, while long /ss/ has two moras.

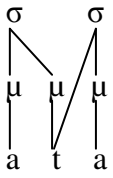
2.2.3.2 Consonant length. The source of consonant length is more difficult to determine than that of vowel length. Hayes (1989) proposes that geminates arise because of association with an underlying mora. Just as long vowels are long because of an additional mora, long consonants are long because of an additional mora. However, Hayes (1989) also posits that this creates ambisyllabicity (discussed below), which is only possible if the geminate is bordered by vowels or short consonants. This is not always the case with geminate /ss/ in Blackfoot, which often occurs before, after, or between other consonants, including other geminate consonants. (6) shows the contrast between a consonant that is not attached to a mora and one that is, following Hayes (1989).

(6) Non-moraic and moraic consonants.

(a) Non-moraic consonant *ata* [ata]



(b) Moraic consonant *at*$_{\mu}$*a* [at:a]



As shown in (6a), a non-moraic consonant surfaces as short in onset position of the second syllable. In (6b), on the other hand, the moraic consonant surfaces in coda position of the first

syllable. The linking to the onset of the second syllable is described in Hayes (1989) as a way to provide an onset for an otherwise onsetless syllable, and, in moraic phonology, is not linked to consonant length. Crucially, Hayes (1989) does not consider the possibility of *ap*$_{\mu}$*ta*, where the moraic consonant is in coda position but is followed by another consonant, and so does not have to form the onset of the following syllable. Since there is no difference between long vowels which are associated with two moras underlyingly and those which receive an additional mora via a phonological process, e.g., compensatory lengthening, it is unclear why consonants associated with an underlying mora, i.e., geminates, should be different from those assigned a mora via a phonological process, e.g., Weight-by-Position (discussed in § 2.2.4).

Elfner (2007, 2006) applies moraic phonology to Blackfoot by positing that a length contrast between consonant sequences in Blackfoot exists because of association with a mora in one case but not the other, e.g., *i.**k**ak*, 'just, only, even' (35) vs. *i**k.k**ak*, 'short, low; associated with childhood/youth' (40). The moraic /k/ in the second example surfaces as a long geminate, while the non-moraic /k/ in the first surfaces in an onset as short. While some sources (Mix 2007, Hogg 1992) draw a distinction between "long" and "geminate" consonants, citing difference between consonants with underlying length and sequences of identical segments, others do not (Davis 2003, Tranel 1991, Hayes 1989). This thesis follows the latter tradition because there is no motivation for positing such a distinction in Blackfoot (Don Frantz, p.c.).

2.2.3.3 Ambisyllabicity. Ambisyllabicity, as set forth in Hayes (1989), is the attachment of a single segment to multiple syllables as the coda to the preceding syllable and the onset of the following syllable. According to Elfner (2006), (7) and (8) show the near minimal pair *nínaa*, 'man', and *nínna*, 'my father', with the medial -*n*- in (8) being attached to both syllables so as to

provide an onset for the otherwise onsetless second syllable. I have followed Elfner (2006) and Hayes (1989) (as well as many others) in representing onsets as being parsed to the syllable rather than the mora of the following vowel.[11]

(7) Prosodic structure for *nínaa*, 'man'

(8) Prosodic structure for *nínna*, 'my father'

The above diagrams represent the view put forth in Hayes (1989) that geminate consonants are attached to an underlying mora. In moraic phonology, intervocalic moraic consonants result not only in extra length phonetically, but also ambisyllabicity in order to avoid an onsetless syllable.[12] However, the current literature does not explain how an interconsonantal geminate would behave. In a context such as *ikksspíísa*, the /ss/ is long, but not necessarily ambisyllabic.

[11] The motivation for parsing onsets directly to the syllable node is based on the fact that onsets do not contribute weight to syllables, while nuclei, and in many languages codas, do. Hayes (1995) describes this as the need to distinguish the fact that it is the vowel, not the onset, which is contributing weight. Parsing the onset directly to the syllable node represents this unambiguously.

[12] See Elfner (2007) for more on ambisyllabicity in Blackfoot, and Hayes (1989) for more on ambisyllabicity in moraic theory.

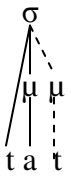
Thus the questions of (i) whether tautosyllabic geminates are possible and (ii) how they would behave in moraic phonology are still open.

Ambisyllabicity does not correlate with length in all languages. Several analyses classify English consonants after lax vowels as ambisyllabic (Trask 1996:20), supported by the fact that speakers are often unsure of how to syllabify words, e.g., *ba.lance* vs. *bal.ance* (Cutler et al. 1986). This type of inconsistent syllabification is not why I mean by ambisyllabicity in this thesis. I take this to be a result of the proscription of lax vowels in open syllables in English, and not a reflection of the underlying structure of the word. I will term this type of ambisyllabicity *perceptual ambisyllabicity*: the inconsistent syllabification of a single short consonant. Ambisyllabicity in Blackfoot and other languages with long consonants results in or from the geminate nature of the consonant: it forms both the coda of the preceding syllable and the onset of the following one. I will call this type of ambisyllabicity *structural ambisyllabicity*, and it is this type that I refer to in this thesis when I use the term ambisyllabic.

2.2.4 Weight by Position

A consonant associated with a mora must appear in a weight-bearing position, i.e., a position usually associated with a mora, if the underlying mora is to be preserved. For most languages this means the coda, since onsets are not held to be associated with a mora. Codas should always be linked to a mora, except in languages that count CVC syllables as light (Hayes 1989). Generally this means that a consonant in a weight-bearing position will be assigned a new mora, thus making the syllable heavier. This is known as Weight by Position (Hayes 1989).

(9) Prosodic structure for *tat*.



In (9), the final /t/ is assigned a new mora because it is in coda position. This process only occurs in languages which count CVC syllables as heavy. In a language that counts CVC syllables as light, the coda consonant would be attached directly to the syllable node (Hayes 1989).

2.3 Optimality Theory

The other main theoretical framework used in this paper is that of Optimality Theory (OT), first put forward by Prince & Smolensky (1993) and McCarthy & Prince (1993). The basic premise of this theory is that rather than phonological rules, languages have correspondence and markedness constraints that prefer or disprefer certain surface pronunciations, termed *outputs* in OT, of underlying forms, which are termed *inputs*. Faithfulness constraints govern the correspondence between the input and output of a given item, mostly in the context of ensuring as much as possible that the surface pronunciation matches the underlying representation. Markedness or well-formedness constraints keep phonetic realizations in line with cross-linguistic trends, e.g., voiced codas are dispreferred, syllable onsets are preferred, syllable nuclei should consist of one vowel (Kager 2001). 2.3.1 provides an introduction to OT constraints and tableaux. 2.3.2 gives general examples of basic constraint

interaction. 2.3.3 details how certain constraints are ranked in Blackfoot. 2.3.4 provides motivation for applying McCarthy's (1993) FINALC constraint in Blackfoot.

2.3.1 OT constraints and tableaux

This section gives an overview of the mechanics of OT, including how constraints are introduced and how constraint violation and satisfaction is represented graphically by tableaux. Kager (2001) is a thorough overview of OT and how it can be used, and much of the discussion here is based on Kager's (2001) explication of OT.

At the heart of OT is the conflict between faithfulness constraints, which keep surface representations in line with the abstract phonological forms, and well-formedness constraints, which seek to keep surface realizations in line with cross-linguistic generalizations based on markedness. This exemplifies the basic concept behind OT: all languages have the same constraints, all of which are violable. The output forms of the corresponding input depends on which constraints are the most important in a given language. Violations, as well as the optimal output, are represented visually through the use of a tableau. A general example is given in (10).

(10) (a) Language A

/ /	X	Y
☞ (a)		*
(b)	*!	

(b) Language B

/ /	Y	X
(a)	*!	
☞ (b)		*

In the tableaux above, a '*' indicates a violation of a given constraint, and a '!' indicates a fatal violation (one that disqualifies the candidate). Shading after the fatal violations indicates that satisfying or violating the lower-ranked constraints is irrelevant after a fatal violation. In (a), the second candidate is disqualified because it violates constraint X, which is more highly ranked in language A. In (b), the first candidate is disqualified for violating constraint Y, which is more highly ranked in language B.

2.3.2 Markedness constraints vs. faithfulness constraints

The most basic constraints come from simple cross-linguistic generalizations. For instance, cross-linguistically the most common syllable type is CV. All languages have CV syllables, and some languages have only CV syllables. V and VC syllables are less common, and more marked, which leads to the formation of the ONSET constraint.

(11) ONSET: Syllables must have onsets.

This means that a given word will be assigned a violation mark for each syllable without an onset, as in (12).

(12) The ONSET constraint.

/t^{s}a/	ONSET
☞ a) t^{s}a	
b) a	*

This captures the generalization that syllables with onsets are more common and less typologically marked than syllables without onsets. The unmarkedness of the CV syllables leads to another generalization: open syllables are less marked than closed ones, e.g., CVC syllables are more marked than CV syllables. This leads to the formulation of the NOCODA constraint.

(13) **NOCODA**: Syllables must be open.

Thus each candidate will be assigned one violation mark per closed syllable, as shown in (14). The dotted line separated the two constraints indicates that they are not crucially ranked relative to one another.

(14) **The NOCODA constraint.**

/t^{s}a/	NOCODA	ONSET
☞ a) t^{s}a		
b) a		*!
c) t^{s}at	*!	

These two constraints account for the markedness differences between CV, CVC, V, and VC syllables, which is all many languages allow. This is because syllables with complex margins are even more typologically marked. These include types such as CCV, CCVC, VCC, etc. The markedness of complex syllable margins is indicated by the *COMPLEX constraint.

(15) ***COMPLEX**: Syllable margins must be simple.

*COMPLEX assigns a candidate a violation mark for each instance of a complex syllable margin, as shown in (16).

(16) The *COMPLEX constraint.

/st^{s}ist^{s}/	*COMPLEX
a) st^{s}ist^{s}	*!*
☞ b) t^{s}is	

These three constraints are the primary markedness constraints on basic syllable types.

All languages have some level of markedness in input forms, whether this is segment types which are marked cross-linguistically or prosodic structures which are uncommon, such as complex syllable margins or extrasyllabic segments. Thus there will of necessity be some conflict between faithfulness and well-formedness, because we can expect all languages to have some level of markedness in input forms. Except in languages that only allow CV syllables, it is the case that more marked syllable structures will exist in the input. This creates tension between well-formedness and faithfulness; without faithfulness constraints all output forms would be the same: whatever form is judged to be the least marked cross-linguistically. One of the primary faithfulness constraints is the MAX constraint.

(17) MAX: Input elements are present in the output.

More accurately, MAX is a family of constraints that can be applied to any level or phonological, prosodic, or morphological structure. The typical constraint used for mapping input segments to output segments is phrased as MAX-IO.

(18) **MAX-IO**: Input segments are present in the output.

(19) shows the results of ranking MAX-IO (a faithfulness constraint) above *COMPLEX and NOCODA (both well-formedness constraints) for the input form *stat*.

(19) **Ranking MAX-IO above well-formedness.**

/anníihk/	MAX-IO	*COMPLEX	NOCODA
a) a.níí	*!**		
b) a.níík	*!*		*
☞ c) an.níihk		*	**

While deletion of one or more segments can reduce syllable markedness, it results in an output form that is no longer faithful to the input. Candidate (a) violates neither of the well-formedness constraints, but is missing three segments present in the input. Candidate (b) is more faithful (and also more marked), but still not completely faithful. In (19) candidate (c) is the optimal candidate because it does not violate MAX-IO at all, and this constraint is crucially ranked above the other two, meaning that satisfaction of this constraint is more important than any number of violations of any number of lower-ranked constraints.

2.3.3 Constraint rankings in Blackfoot

This section details some specific phonological and structural constraints that will be useful to describe the phonological structure of Blackfoot. The previous section introduced the MAX family of constraints, which ensures that input elements are present in the output. Since this thesis uses moraic theory as one theoretical framework, another constraint that will be useful is the MAX-μ constraint, which militates against input moras not present in the output.

(20) **MAX-μ**: Input moras are present in the output.

MAX-μ has been used to explain length contrasts by many different sources, including Rosenthall (1994), Sherer (1994), and, regarding Blackfoot, Elfner (2007, 2006). In Blackfoot this constraint is most relevant for long vowels. Short vowels are associated with one mora, while long vowels are associated with two. A vowel with two moras should surface as a long vowel if it is not to violate the MAX-μ constraint (Elfner 2007). MAX-μ must be an important constraint in Blackfoot, because without assuming it to be fairly high ranked, there would be no geminate stops, and far fewer codas, since geminate stops and the codas that accompany them arise from underlyingly moraic consonants (Elfner 2007, 2006). Both geminates and long vowels arise from association with an underlying mora, and since geminates and long vowels are marked cross-linguistically, these structures would not appear in the output if MAX-μ were not a highly ranked constraint. This faithfulness constraint conflicts with *LONGV, a markedness constraint supported by the universal tendency for long vowels to be more marked than short vowels cross-linguistically, e.g., there are languages which have only short vowels, but no languages which have only long vowels.

(21) ***LONGV**: Output vowels should be linked to a single mora.

(22) shows one instance of MAX-μ at work.

(22) Tableau for *nínaa*, 'man'

/ni$_{\mu}$na$_{\mu\mu}$/	MAX-μ	*LONGV
a) nina	*!	
☞ b) ninaa		*

As shown in (22), MAX-μ must be ranked above *LONGV for any long vowels to surface, e.g., in languages with long vowels. Since candidate (a) does not preserve both input moras associated with the final /a/, candidate (b) is the optimal output.

The MAX family of constraints can also be applied to morphological structure. Prince & Smolensky (1993) notes that faithfulness constraints for root morphemes always take precedence over faithfulness for affixes (see also Alderete et al. 1999). The domain of a faithfulness constraint such as MAX-IO is presented in parentheses after the basic constraint.

(23) MAX-IO(root): Input segments in a root are present in the output.

This constraint specifies a specific morphological domain for the constraint, to reflect the fact that generally it is not the case that all deletion is equally marked. The deletion of segments in a root morpheme is, as asserted in Prince & Smolensky (1993), universally more marked than deletion of segments in affixes.

(24) MAX-IO(affix): Input segments in an affix are present in the output.

These two constraints are shown to be ranked relative to each other as in (25).

(25) Ranking of MAX-IO(root) and MAX-IO(affix).

MAX-IO(root) >> MAX-IO(affix)

This means that in a case where they conflict, the faithfulness of a root will always be preserved at the expense of affix faithfulness.[13] This can be illustrated by the 3rd person suffix in Blackfoot. Usually, this suffix takes the form *-wa*, as in (26).

(26) 3rd person suffix in Blackfoot.

	3rd person form	Gloss	Root	
a)	ikkakíí**wa**	it is low	ikkakii	(41)
b)	ikkstsáánisi**wa**	he got cold chills	ikkstsáánisi	(45)
c)	ikkstsíí**wa**	it is/was narrow/thin	ikkstsii	(45)
d)	piitsistóyi**wa**	it was before	piitsistóyi	(189)
e)	kííhtsipimi**wa**	it is spotted/striped	kiihtsipimi	(115)

However, in cases of consonant-final stems, the *-w-* is deleted (Frantz & Russell 1995). This is illustrated in (27) for the Blackfoot determiner *oma*, which is analyzed by Frantz (1991) as a combination of a determiner root *om-* and the third person suffix *-wa*. Here and throughout I have bolded the root morpheme in the input forms. The highest-ranking constraint WF represents syllable well-formedness generally, rather than a specific well-formedness constraint. I have chosen to represent well-formedness this way because attributing the disqualification of

[13] This will only be relevant if both constraints are dominated by some well-formedness constraint which demands deletion of a segment.

the first candidate due to just the first syllable coda or the -mw- cluster would be an oversimplification.

(27) Tableau for *oma*, 'that'

/**om**+wa/	WF	MAX-IO(root)	MAX-IO(affix)
a) om.wa	*!		
b) o.wa		*!	
☞ c) o.ma			*

Candidate (a) is disqualified because it violates syllable well-formedness: codas are dispreferred cross-linguistically, and -mw- is not a licit consonant cluster in Blackfoot. Candidates (b) and (c) are both well-formed, but (c) is chosen over (b) because it preserves root faithfulness, which is preferred over affix faithfulness.

Another strategy in many languages for reducing markedness, especially in certain consonant clusters that are disallowed by phonotactics, is epenthesis. However, this violates another class of faithfulness constraints, classed as DEP(ENDENCE).

(28) DEP: Output elements are present in the input.

Just like MAX, DEP can be applied to any level of structure, from prosodics to phonetics. The standard constraint for prohibition of segment epenthesis is DEP-IO.

(29) DEP-IO: Output segments are present in the input.

If this faithfulness constraint is ranked above some or all well-formedness constraints, output syllables will contain marked structures such as complex syllable margins in order to satisfy faithfulness to the input form. The ranking of DEP-IO and *COMPLEX for Blackfoot is shown in (30).

(30) Tableau for *stsiki*, 'another'.

/stsiki/	DEP-IO	*COMPLEX
a) si.tsi.ki	*!	
☞ b) stsi.ki		*

In (30), candidate (a) avoids marked complex syllable margins, but only by introducing an output segment not present in the input, which is a violation of DEP-IO. This makes candidate (b) the optimal candidate because it is faithful to the input form, even though it violates the *COMPLEX well-formedness constraint.

In a language like Blackfoot with onsetless syllables, it must be the case that DEP-IO is ranked higher than ONSET, otherwise syllables with no input onset would surface with an epenthetic one.[14]

(31) Tableau for *aakííkoan*, 'girl'.

/aakííkoan/	DEP-IO	ONSET
a) waa.kíí.koan	*!	
☞b) aa.kíí.koan		*

[14] In fact, ONSET seems to be ranked so low in Blackfoot that many roots with an initial consonant are pronounced without it.

(31) shows the relative ranking of DEP-IO and ONSET. DEP-IO must be ranked higher than ONSET, since not all Blackfoot syllables have onsets. If the opposite were true, Blackfoot would have no onsetless syllables.

2.3.4 Motivating the FINALC constraint

One of the most immediately noticeable aspects of Blackfoot phonology is the devoicing or deletion of final vowels. In many cases this reduction extends so far as to actually be nothing but an oral gesture, with no pulmonic force whatsoever (Bliss 2009). This can be taken to parallel Miyashita's (1998) analysis of final syllable devoicing in Tohono O'odham as being due to a progressive decrease in subglottal pressure. The final -a in the extremely common 3rd person suffix *-wa* is usually completely inaudible, rather than merely devoiced. Thus in Blackfoot there appear to be four realizations of vowel "deletion": full pronunciation of the vowel, which is rare, devoicing of the final vowel, which is more common, reduction of the final vowel to an oral gesture, which is probably the most common, and complete elimination of the vowel. This final vowel deletion also occurs with the plural suffixes *-iks(i)*, 'animate plural' and *-ists(i)*, 'inanimate plural', as well as less predictably in various other constructions. Bybee (2001) notes that high frequency morphemes are most subject to change, reduction, or deletion, and this is borne out by the Blackfoot data. While the continuum from deleted vowel to fully pronounced vowel is not entirely predictable, it is certainly the case that these three high frequency suffixes are the most affected in terms of final vowel reduction. In roots, final vowels are sometimes devoiced, but never deleted.

2.3.4.1 The FINALC constraint. McCarthy (1993) suggests the FINALC constraint to account for the fact that, cross-linguistically, word-final codas tend to be substantially less marked than word-medial codas.

(32) **FINALC**: Words should not end in a vowel.

Though not all Blackfoot words end in a consonant, many do, especially due to reduction of the suffixes *-wa*, 'third person', *-iksi*, 'animate plural', and *-istsi*, 'inanimate plural'. (33) gives an example of a word containing the third person suffix *-wa*. The first line shows a phonetic representation, follow by a morpheme breakdown, interlinear gloss, and English translation.

(33) ***pookááwa*, 'child'**

[poːkáːw]

pookáá-wa

child-3[15]

'child'

Person-marking is obligatory in Blackfoot, and signals whether or not a noun phrase is the topic/focus of the utterance. Each discourse segment has one NP marked as 3rd person, also called proximate, and may have one or more non-topic NPs marked as 4th person, also called obviative or minor third person (Frantz 1991). This obligatory person-marking contributes to the

[15] 3 = 3rd person

widespread usage of the suffix *-wa*. (34) shows the deletion[16] of the final vowel in *pookááwa*. In the examples below the root is bolded in the input.

(34) Tableau for *pookááwa*, 'child', from *pookáá*

/**pookaa**+wa/	DEP-IO	FINALC	MAX-IO
a) pookaawaw	*!		
b) pookaawa		*!	
☞c) pookaaw			*

This constraint ranking derives the correct pronunciation, but fails to explain the well-formedness of the many Blackfoot words that do end in vowels, as in (35).

(35) *nitáyimmi*, 'I am laughing'

[nitájɪmːi̥]

nit-á-yimmi

1-dur-laugh[17]

'I am laughing'

In (35), *nit-* represents the 1st person prefix and *-á-* what Frantz (1991) terms the 'durative' (see also Dunham 2007 and Greene 2009). (36) shows the incorrect output for *nitayimmi* based on the constraint ranking used above. The 💣 represents a candidate which the constraint ranking judges to be optimal, but which is not the attested form.

[16] This is another case where the choice is not merely between X and Y, but between shades of gray in between. Final vowels are not simply retained or deleted; they may be devoiced or reduced to an oral gesture.
[17] 1 = 1st person, dur = durative

(36) Tableau for *nitáyimmi*, 'I am laughing', from *yimmi*, 'laugh'

/nit+a+**yimmi**/	DEP-IO	FINALC	MAX-IO
a) nitayimmim	*!		
b) nitayimmi		*!	
💣c) nitayimm			*

In (36) the constraint ranking developed in (34) incorrectly predicts the surface output *nitayimm*, whereas the actual pronunciation is *nitayimmi*, without final vowel deletion. To correct this ranking we must take into account root faithfulness versus affix faithfulness.

2.3.4.2 Ranking root faithfulness above affix faithfulness. In Blackfoot, as in all languages studied to date, root faithfulness outranks affix faithfulness. By taking this into consideration we can rework the tableaux in (34) and (36) into the correctly ranked tableaux in (37) and (38).

(37) Tableau for *pookááwa*, 'child'

/**pookaa**+wa/	DEP-IO	MAX-IO(root)	FINALC	MAX-IO(affix)
a) pookaawaw	*!			
b) pookaawa			*!	
☞c) pookaaw				*

(38) Tableau for *nitáíyimmi*, 'I am laughing'

/nit+a+**yimmi**/	DEP-IO	MAX-IO(root)	FINALC	MAX-IO(affix)
a) nitayimmim	*!			
☞ b) nitayimmi			*	
c) nitayimm		*!		

It is evident from these examples that the ranking must be MAX-IO(root) >> FINALC >> MAX-IO(affix), which explains why affix vowels may be deleted to satisfy the FINALC constraint, whereas root vowels may not be.

2.3.4.3 Ranking of FINALC and *COMPLEX. As a final note regarding the FINALC constraint, it is evident that it must be ranked above *COMPLEX, because it is often the case that final vowel deletion creates complex codas out of consonant clusters that otherwise would be parsed to separate syllables.

(39) Tableau for *ohpííkiistsi*, 'his teeth'

/ohpííkiistsi/	FINALC	*COMPLEX
a) oh.pií.kiis.tsi	*!	
☞ b) oh.pií.kiists		*

As seen in (39), FINALC must be ranked higher than *COMPLEX, because otherwise the final *-i* in plural suffixes would remain in the output forms. This makes (b) the optimal candidate. Certainly the presence of a vowel fully violates maximality, while the complete absence fully satisfies it. However, in Blackfoot we also find final vowels devoiced or sometimes reduced to a mere gesture. Both of these processes reduce the markedness of the final vowel, and thus while they might violate FINALC, they do it to a lesser extent than a fully articulated and voiced vowel. There is currently no straightforward way to represent this type of gradience in OT, and I leave it to future authors to determine the best way to account for this gradience within the OT framework.

2.4 Summary

This chapter has surveyed the main theoretical frameworks of this thesis. First discussed was Moraic Theory, developed from Hyman (1985), McCarthy & Prince (1986), and Hayes (1989), and how it is relevant for Blackfoot syllable structure and phonological processes. Also included were prosodic structures for Blackfoot words containing long vowels and long consonants, introducing the representation of moraic phonology to be used throughout this thesis. Next Optimality Theory was introduced, as well as several basic families of constraints. These constraints and constraint rankings were applied to several Blackfoot words. Also described was how markedness constraints and faithfulness constraints are resolved in Blackfoot. (40) reviews the constraints surveyed in this chapter. Other more specific constraints will be introduced later; those in (40) are some of the most basic markedness and faithfulness constraints necessary for analyzing Blackfoot in Optimality Theory. Most are taken from or based on McCarthy & Prince (1993), except where noted otherwise earlier in this chapter.

(40) **DEP-IO**: Output segments are present in the input

***COMPLEX**: Syllable margins are simple.

MAX-μ: Input moras are present in the output.

***LONGV**: Output vowels should be linked to a single mora.

MAX-IO(root): Input segments in a root are present in the output.

MAX-IO(affix): Input segments in an affix are present in the output.

FINALC: Words should not end in a vowel.

(41) shows the final rankings of these constraints.

(41) DEP-IO >> MAX-IO(root) >> FINALC >> MAX-IO(affix), *COMPLEX

MAX-μ >> *LONGV

Chapter 3 discusses the distribution of /s/ in Blackfoot, and how the proposal of moraic /s/ can be used to explain the occurrence of /s/ in complex onsets and as a syllable nucleus. Chapter 4 will continue this analysis within the framework of Optimality Theory.

CHAPTER 3: MORAIC /S/ IN BLACKFOOT

3.1 Introduction

Previous chapters have introduced the research questions of this thesis and the theoretical frameworks in use here, as well as surveying constraint rankings in Blackfoot. The purpose of this chapter is to take an in-depth look at the distribution of /s/ and how it differs from other phonemes in Blackfoot. /s/ is the only phoneme that makes syllabification difficult in Blackfoot. In words without /s/, syllabification is straightforward, since except for syllables involving /s/, the maximal Blackfoot syllable is CVVCC, and all geminates are intervocalic and thus can be explained within moraic phonology as detailed in Hayes (1989). The peculiarity of the phoneme /s/ in Blackfoot is motivated by three factors: (i) all geminates are intervocalic except some instances of /ss/, (ii) all complex onsets involve /s/, and (iii) all heterorganic consonant clusters involve /s/. This chapter offers a unified explanation for three unusual aspects of Blackfoot phonology related to the phoneme /s/ by proposing that /s/ is inherently moraic, and can act as a syllable nucleus. Proposed syllable boundaries for several words in the standard Blackfoot orthography are shown in the first column of (1). I have used /s/ as a syllable nucleus in some examples because without doing so there is often no way to know how to syllabify words in Blackfoot. An unsegmented phonetic representation is given in the second column, and the gloss is given in the third column.

(1) /s/ in Blackfoot.

a) ii.kóm.**ss**.pi.ka'.p**ss**.iwa	[iːkóm**sː**pikaʔp**sː**iw]	he's a burden	(165)
b) ik.k**ss**.píí.**s**a	[ɪk**sː**píː**s̥**a]	hit him!	(45)

c) i**s**.**s**pay**s**.**s**too	[ɪ**sː**paj?**sː**toː]	mule deer	(87)
d) i**s**t.toh.kaii.pi**s**.**st**si	[ɪ**s**tːo̥χkejpɪ**sː**tˢ]	thin fabric	(91)
e) **s**kai'.ká.ka.not.t**s**ii.yii**st**.ko.wa	[**s**ke?kákanotːˢiːjiː**st**ˢkowḁ]	trees are sparse	(113)

As shown in (1), /s/ has a very different distribution from most consonants. (a)-(c) show that geminate /ss/ can occur between consonants, as well as before or after consonants, also illustrated by (d). (e) shows /s/ occurring in a complex onset, a complex coda (also shown in (d)), and in the affricate /ts/. Since /s/ has a very different distribution from other consonant phonemes at the surface level, it stands to reason that /s/ may be underlyingly different from other consonants. This chapter explains the distribution of /s/ and proposes that /s/ is always associated with an underlying mora. The following sections propose two primary ways in which moraic /s/ reduces the markedness of the seemingly complex syllables involving /s/: (i) an extrasyllabic moraic consonant is less marked than a non-moraic one, and (ii) moraic /s/ can act as a syllable nucleus. I show that positing moraic /s/ is a useful assumption for phonological analysis in Blackfoot.[18]

§ 3.2 discusses how a moraic /s/ explains the ability of /s/ to participate in complex onsets, all of which have /s/ as the first member. § 3.3 discusses how the proposal of moraic /s/ in Blackfoot predicts the ability of /s/ to act as a syllable nucleus, and offers support for this position. § 3.4 gives a summary and conclusions, including an overview of native speaker intuitions about /s/ in Blackfoot.

[18] The extension of this analysis to other languages in which /s/ is exceptional may prove worthwhile, but is outside the scope of this thesis.

3.2 Moraic /s/

The occurrence of /s/ in complex onsets supports the proposal of moraic /s/. This section considers the issue of how the proposal of moraic /s/ reduces syllable margin markedness by parsing the first member of a complex onset to a prosodic category higher than the syllable. To my knowledge there is no complex onset in Blackfoot that does not involve /s/. (1) repeats data from Chapter 1 on complex onsets involving /s/ in word-initial and word-medial position.

(1) Complex onsets in Blackfoot

Word-initial

a)	**sk**iim	[**sk**iːm]	female animal	(214)
b)	**sksks**in.ni[19]	[**skˢkˢs**ɪnːi̥]	crack (e.g., glass)	(214)
c)	**sp**á.tsi.ko[20]	[**sp**átˢiko]	sand	(220)
d)	**st**á.mi.ta.poot	[**st**ámitapoːt]	just go there!	(232)
e)	**stsí**.ki	[**stˢí**ki̥]	another	(232)

Word-medial

f)	is.**sp**ay.ss.too	[ɪs**sp**ajʔsːtoː]	mule deer	(87)
g)	ksis.**st**o.ním.maa.pio.yiis.tsi	[kˢɪs**st**oním:aːpʲojiːstˢ]	sheds	(120)
h)	ní.toh.tois.**sk**i.maa	[nítoχtɔjs**sk**imą̊]	I herded	(151)

[19] Don Frantz (p.c.) indicated to me that one or more of these /s/s may be syllabic, rather than being a sequence of two affricates following a singleton /s/.

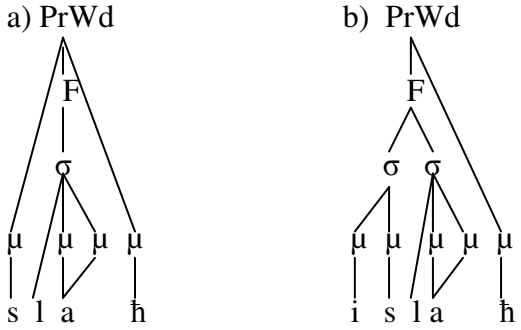
[20] This is the only entry in Frantz & Russell (1995) that begins with /sp/, so the status of /sp/ as a licit word-initial onset in Blackfoot is uncertain.

As shown in (1), all complex onsets have /s/ as their first member and a stop or affricate as their second member. The fact that only /s/ can participate in complex onsets suggests that there is something different about this phoneme in Blackfoot.

3.2.1 Extrasyllabic /s/

To explain the fact that /s/ readily participates in complex onsets, I propose that in these cases /s/ is extrasyllabic, i.e., parsed to some prosodic category higher than the syllable, so that at the syllabic level, an onset involving /s/ is not actually complex. This parallels Kiparsky's (2003) analysis of certain initial consonant clusters in Arabic, as shown in (2)[21].

(2) Extrasyllabic consonants in Arabic (from Kiparsky 2003).



The extrasyllabic /s/ in (2a) retains its mora to satisfy mora preservation. This preservation does not specifically violate any markedness constraints because it is not parsed to a syllable node. If the /s/ is parsed to a syllable node, we would expect to find it in a weight-bearing position, i.e.,

[21] Kiparsky (2003) lists three main dialect groups of Arabic: VC-dialects, C-dialects, and CV-dialects, which differ from each other based on syllable structure. The syllabification shown in (2) is what Kiparsky proposes for VC- and C-dialects of Arabic, which include Iraqi, Syrian, and Tunisian varieties, as well as several others.

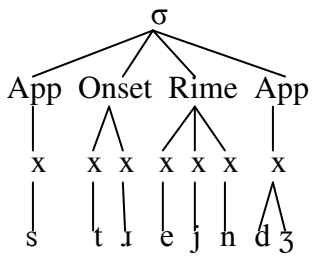
not in onset position. In some cases, an *i-* is inserted before the /s/: *is.laaħ*[22], shown in (2b) (Kiparsky 2003). In this way the /s/ can be parsed to a syllable without a complex margin, since the consonant cluster is being split between two syllables. Crucially, the /s/ can still retain its mora, since it occurs in the coda, which is a weight-bearing position associated with a mora.

This parallels exactly the pattern of word-initial moraic /s/ in Blackfoot discussed below. Just as in Arabic, the insertion of the vowel is in free variation with its complex onset counterpart. This type of insertion occurs only in VC- and C-dialects of Arabic; in CV-dialects the /s/ loses its mora: *si.laaħ*. Thus in cases like these is for the mora attached to the /s/ is deleted, violating mora preservation. The tendency toward mora preservation in Blackfoot is discussed in 4.2 within the framework of Optimality Theory.

According to Selkirk (1995), the reason extrasyllabic segments are marked is that prosodic elements should be parsed to the category directly above them, i.e., segments should be parsed to moras, moras should be parsed to syllables, etc. Because of this, extrasyllabic segments are progressively more marked the higher the prosodic category to which they are parsed. When dealing with extrasyllabic segments parsed to a foot or prosodic word, this means that a segment attached to a mora would be less marked, because the mora is higher up the prosodic structure than the segment itself. Thus while a segment attached directly to the prosodic word is skipping three prosodic categories (mora, syllable, foot), a moraic segment attached to the prosodic word only skips two (syllable, foot). I take this to parallel Borowsky's (1989) analysis of coronals in English, which also appear in complex syllable margins, as shown in (4).

[22] This i-insertion is also evident in English language learners whose native language is Arabic (see Alezetes 2007). The various dialects of Arabic have different insertion points for breaking up CC clusters, yielding CVC or VC.C sequences depending on the dialect. Interestingly, Alezetes (2007) provides data which suggests that in both types of dialects, sC clusters are resyllabified as is.C sequences, rather than an sVC sequence.

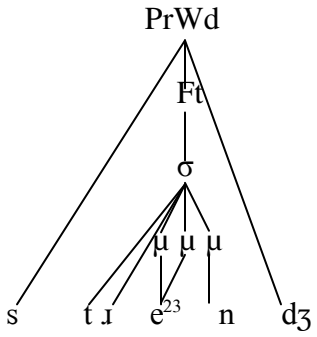
(3) Coronal appendices in English (from Borowsky 1989).



App = Appendix

Borowsky (1989) uses the notion of appendices that attach to the syllable node separately from the onset or coda in X theory. Since moraic theory does not recognize separate nodes for onset, rime, etc., I will be using the notion at a higher level of prosodic structure, proposing that these appendices, which only occur at word edges, attach directly to the prosodic word, which parallels Roca & Johnson's (1999) analysis of appendices in English. (4) shows a revision of (3) in moraic theory.

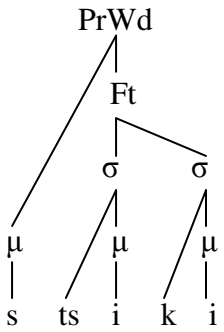
(4) Extrasyllabic coronals in moraic theory.



[23] While the literature on English does not comment on the moraic representation of diphthongs, here I have chosen to represent the diphthong in "strange" as a long /e/, since this diphthongization of tense vowels in English is predictable, and in this case does not arise from the treatment of two phonologically separate segments as a single vowel (Roca & Johnson 1999).

This same type of extrasyllabicity would explain the ability of /s/ to participate in complex onsets in Blackfoot. (5) shows the proposed prosodic organization for *stsiki*, 'another'.

(5) Prosodic structure for *stsiki*



In (5), the /s/ is parsed directly to the prosodic word, avoiding what would otherwise be a complex onset parsed to the syllable node. Some speakers seem not to allow these complex onsets, and instead insert an epenthetic vowel (somewhere between ə and ɪ) before the initial /s/.

I believe that this type of variance can and should be accounted for within the theory of moraic /s/ in Blackfoot. If /s/ is indeed always moraic in Blackfoot, then it needs to be in a weight-bearing position if it is not extrasyllabic. This means that the /s/ must be in a coda or nucleus when it is not extrasyllabic, i.e., speakers for whom the type of extrasyllabicity proposed above is unacceptable may seek to reduce the complexity of the cluster by putting the initial /s/ after the epenthetic vowel, e.g., *əstsiki*. This type of vowel insertion crucially never takes place between the two consonants: **sitsiki* is an unattested form. When epenthesis is involved, it always occurs before the cluster, creating a coda-position /s/, as in *əstsiki*. The proposal that /s/ is moraic explains the distribution of /s/ in weight-bearing positions, but may seem problematic

for instances of /s/ in onset position. In simple onsets, /s/ most likely loses its mora, but a full exploration of this is beyond the scope of this thesis.

3.2.2 Sonority sequencing in complex onsets

This section discusses sonority and sonority sequencing. At first glance, all Blackfoot complex onsets violate sonority sequencing. These apparent violations can be explained by the proposal that initial /s/ in complex onsets is extrasyllabic, and thus does not participate in sonority sequencing.

3.2.2.1 Sonority. The concept of sonority dates back to Sievers (1881), who discussed the difference between sonorants (*Sonoren*) and obstruents (*Geräuschlaute*). Sievers further divided the sonorants into vowels (V*ocale*), liquids (*Liquidae*), and nasals (*Nasale*), and the obstruents into stops (*Verschlusslaute*) and fricatives (*Spiranten*). Any basic definition of sonority references the idea that certain sounds have more sonority, or resonance, than others. While an exact theoretical definition is difficult to pin down, for our purposes it is enough to specify sonority as that acoustic quality which sonorants have more of than obstruents. Recognition of the importance of sonority has continued with, among others, Hooper (1976), Selkirk (1982), Vennemann (1988), Clements (1990), Prince & Smolensky (1993), Zec (1995), Gnanadesikan (1997), and Parker (2002). Parker (2002) notes that researchers disagree as to whether there is any functional difference in sonority between vowels and glides, between voiceless fricatives and voiced stops, or between stops and affricates. Because of this, he suggests the ranking vowels > liquids > nasals > obstruents as the minimal sonority scale that can be universally agreed upon. While the relative ranking of voiceless fricatives and voiced

stops is debatable, fricatives are generally agreed to be more sonorous than stops, as reflected in most sonority scales suggested in the past fifty years, and thus we can further subdivide the class of obstruents into fricatives > stops. This ranking is supported by the sequencing of stops and fricatives in many languages. Since Blackfoot does not have a voicing distinction, this question is irrelevant to the discussion contained herein. This sonority scale can be used to explain the distribution of complex onsets and codas cross-linguistically, as many languages only allow such complex margins if they obey sonority sequencing.

Elfner (2005) adapts Parker's (2002) generalizations to the specifics of Blackfoot phonology. She makes several subdivisions of Parker's minimal scale by ranking low vowels > mid vowels > high vowels > glides. While these subdivisions may be useful in terms of predictive power, especially the separation of glides from vowels, they are not relevant to the analysis below, and in the interest of avoiding controversy, I will leave these divisions out of my sonority scale. (6) shows the sonority scale I use for Blackfoot. To avoid confusion, in (6) I phonetic realizations of Blackfoot phonemes rather than orthographic representations.

(6) Sonority scale.

5	vowels	a, o, i, j, w	*highest sonority*
4	glottals	ʔ	
3	nasals	m, n	
2	fricatives	s, x	
1	stops	p, t, k, ts, ks	*lowest sonority*

One of Elfner's (2005) proposals that I adopt here is the ranking of the glottal stop below vowels but above nasals on the sonority scale. Elfner uses this ranking to explain certain phonological processes in Blackfoot, and in fact several recent sonority hierarchies (Parker 2002, Gnanadesikan 1997) have placed glottals in exactly this location on the universal sonority hierarchy. Further verification of this ranking is beyond the scope of this thesis, but the predictive power of this ranking is useful in Elfner's (2005) analysis, and is relevant for the analysis below in terms of avoiding level sonority across syllable boundaries: placing the glottal stop higher than other stops on the sonority scale explains the well-formedness of the common /'/ + stop clusters in Blackfoot. Because of these reasons, I have reproduced this ranking in my sonority scale in (6). I have left liquids from the ranking because they are not present in Blackfoot. In many ways [x] patterns with [ʔ], and future research may suggest that on the sonority scale [x] should be at the same level as the glottal stop. The velar fricative [x] in Blackfoot is in many cases a reflex of proto-Algonquian glottal */h/ (Proulx 1989), and [x] has the same distribution as [ʔ] (it only appears in codas), one which is different from all other phonemes. However, since this is a proposal that needs to be tested, I will not include it here.

3.2.2.2 Sonority sequencing. Sonority sequencing is the general cross-linguistic tendency for sonority of segments to rise from beginning to middle and fall from middle to end. For instance, in English, *tr-* is a licit onset because the second segment is more sonorous than the first, but *nt-* is not, because the second segment is less sonorous. All complex onsets in Blackfoot involve a more sonorous segment as the first member, since all complex onsets are /s/ + stop clusters. The fact that this segment is always /s/ may be relevant. Just as in Blackfoot, English complex onsets may violate sonority sequencing if the first segment is /s/, as in *str-*,

where the more sonorous segment /s/ comes before the less sonorous segment /t/. See Morelli (1999) for the proposal that, contra expectations based on universal sonority sequencing, /s/ + stop clusters are the least marked consonant clusters cross-linguistically.

Sonority sequencing is covered in detail in Vennemann (1988), as is Vennemann's syllable contact law, which states that sonority should decrease across a syllable boundary. Both of these refer to the fact that well-formed syllables tend to obey certain rules concerning the sonority of segments in onsets, codas, and across syllable boundaries. Well-formed onsets increase in sonority, well-formed codas decrease in sonority, and well-formed syllable boundaries feature a decrease in sonority, i.e., the boundary X.Y is preferred when X is more sonorous than Y. While many languages violate some or all of these well-formedness conditions, the fact that many languages do not, and that these tendencies exist cross-linguistically even in unrelated languages, suggests that those syllables that obey Vennemann's syllable preference laws represent the least marked syllables. In terms of complex syllable margins, this means that complex onsets should rise in sonority from word edge to syllable nucleus, and complex codas should fall in sonority from nucleus to word edge, e.g., in Tohono O'odham, complex codas are only possible if the final member is of low sonority; complex codas may not end with a sonorous segment such as nasal or liquid (Miyashita 2003). In Tohono O'odham, only two general categories are necessary to explain the distribution of complex onsets: sonorants and obstruents. In other languages, finer distinctions are necessary. Thus, while the overall ranking of segments is universal, the subdivisions between categories are language-specific. In Blackfoot, sonorants do not participate in complex syllable margins, but complex onsets never involve two segments of equal sonority, since they always consist of a

fricative and a stop or affricate. The question of why onsets that violate sonority sequencing are allowed is answered if we posit extrasyllabicity for /s/ in these cases.

3.2.2.3 Sonority sequencing in Blackfoot complex onsets. The fact that Blackfoot complex onsets violate universal sonority sequencing raises an interesting question about the status of /s/ in Blackfoot, because if complex onsets were allowed generally, we would expect to find at least some complex onsets composed of other consonants, or at least complex onsets that satisfy sonority sequencing, e.g., *sn-*.[24] It cannot be the case that Blackfoot requires any kind of minimal sonority distance for complex onsets, since fricatives and stops are only one level apart, and these are the only types of complex onsets that occur in Blackfoot. This suggests that an extrasyllabic analysis of initial /s/ in complex onsets in Blackfoot is useful, since these segments do not follow constraints such as sonority sequencing.

It is noteworthy that /s/ only occurs as the initial segment of complex onsets. As the second member it could not be extrasyllabic, so this fact about segment ordering supports the hypothesis that /s/ in complex onsets is extrasyllabic. However, there are to my knowledge no contexts in which /s/ would be analyzed as the second member of a complex onset. /ts/ and /ks/ sequences are always analyzed as affricates rather than complex onsets, and onsets such as /ns/ and /ms/ are highly marked cross-linguistically and do not occur in Blackfoot. Frantz & Miyashita (2009) and Derrick (2006) show that different types of /s/ have different durations, including affricate /s/, singleton /s/, and geminate /ss/, and future research may be able to determine if in fact there is a distinction between syllable-initial /ts/ and /ks/ versus /t^{s}/ and /k^{s}/.

[24] A somewhat differing analysis, but one which supports the exceptionality of /s/, can be found in Broselow (1993), which notes that /s/ + stop clusters seem to be treated as single units by Arabic L2 speakers of English in terms of epenthesis to break up those clusters, i.e., /s/ + stop clusters are never separated by epenthesis. Onsets which obey sonority sequencing, on the other hand, are readily broken up by epenthesis. It is this latter type which is not found at all in Blackfoot.

Elfner (2007) mentions in passing that Blackfoot contrasts these pairs, citing differences in duration of the /s/, but does not include any references or illustrative data.

The fact that /s/ is the only fricative in Blackfoot that can occur in onsets cannot be overlooked, and it may be in fact possible to say that fricatives in Blackfoot can participate in complex onsets, be extrasyllabic, etc. However, this hypothesis cannot be tested, since /s/ is the only phoneme that can occur in onset position, and thus it is most useful to assume that only /s/ can act this way, unless there is reason to extend this analysis to the class of fricatives in Blackfoot. Future research on the status of /s/ and other fricatives in other Algonquian languages may shed light on the status of /s/ in Blackfoot.

One datum that may support the peculiarity of fricatives in general rather than just /s/ is the devoicing of short vowels in syllables ending with [x] (orthographically /h/), e.g., *ómahk*, 'big' [ómḁχk]. Since the fricative takes on the qualities of the devoiced vowel, there is some motivation for positing the deletion of the vowel, making the velar fricative the syllable nucleus (Frantz 1991). The limited distribution of [x] makes it difficult to compare with the distribution of /s/, but future research may shed light on whether fricatives as a class in Blackfoot have special properties. The claim that [x] forms the syllable nucleus in these cases would support the hypothesis that /s/ can be a syllable nucleus in Blackfoot, because any language which has syllabic obstruents has a syllabic /s/ (Bell 1978).

3.2.3 Summary of moraic /s/.

The proposal of moraic /s/ in Blackfoot explains why it can be extrasyllabic while other consonants cannot: the parsing of a moraic segment to the prosodic word is less marked than the parsing of a non-moraic segment. This extrasyllabic analysis of /s/ in complex onsets also

explains why complex onsets in Blackfoot do not satisfy sonority sequencing. Claiming that /s/ is moraic in Blackfoot makes a further prediction. Since the usual proposal is that moraic segments are limited to nucleus position, it would be odd to propose a moraic segment that only occurred in onset and coda position, but never in nucleus position. If Blackfoot /s/ is moraic, as are vowels, it should be able to act as a syllable nucleus. Evidence that this is in fact the case is considered in the next section.

3.3 Syllabic /s/

The previous section considered evidence that /s/ in Blackfoot complex onsets is extrasyllabic, and that the proposal of moraic /s/ would reduce the structural markedness of this extrasyllabicity. This section details several reasons for positing syllabic /s/ in Blackfoot, looking first at ambisyllabicity and the distribution of geminate /ss/, and then turning to the role of sonority sequencing in supporting syllabic /s/. Derrick (2007) suggests that /s/ is syllabic in Blackfoot, and supports this claim with typological and phonetic evidence, including the general simplicity of the Blackfoot syllable, with /s/ clusters being the only outliers, and the difference in duration between different types of /s/. While the proposal of syllabic /s/ does explain some of these phenomena, syllabic /s/ still requires some underlying motivation. My proposal that /s/ is inherently moraic in Blackfoot, as discussed in the previous section, supports the notion of syllabic /s/: the inherent moraicity of /s/ licenses it to act as a syllable nucleus. It is important to note that it is the *inherent* moraicity of /s/ which predicts that it can act as a syllable nucleus. Coda consonants are moraic in languages with heavy CVC syllables, but we do not expect them to be syllabic. If /s/ in Blackfoot is inherently moraic, as are vowels, it should be able to act as a syllable nucleus. However, just as vowels can also be non-moraic, e.g., /u/ becomes /w/ and /i/

becomes /j/, we should not expect /s/ to be syllabic in every instance. This section will first discuss ambisyllabicity in Blackfoot, and why geminate /ss/ cannot always be ambisyllabic. Then I turn to the distribution of geminate /ss/ and how it parallels the distribution of long vowels rather than other geminate consonants. Next I describe the apparent sonority sequencing violations in Blackfoot words, and how these can be explained with the notion of syllabic /s/. Finally I look at root-initial geminate /ss/ and how the proposal of syllabic /s/ explains the presence of geminates in this unexpected position.

3.3.1 Ambisyllabicity in Blackfoot.

Because /ss/ in Blackfoot occurs between consonants, not all instances of geminate /ss/ can be ambisyllabic. In a sequence such as -CssCssC-, it is impossible for both instances of geminate /ss/ to be split between two syllables without creating a consonantal nucleus. Positing syllabic /s/ in Blackfoot eliminates the need to try to parse these geminates as ambisyllabic, since syllable nuclei can be long without being ambisyllabic. The following section considers in detail the question of how to analyze seeming instances of tautosyllabic /ss/.

3.3.2 Distribution of geminate /ss/.

This section shows how positing syllabic /s/ in Blackfoot explains the unexpected presence of tautosyllabic geminate /ss/ in Blackfoot. Just as short /s/ has a different distribution from other phonemes, appearing in complex onsets and codas, geminate /ss/ has a very different distribution from other geminates. As will be shown in this section, the distribution of geminate

/ss/ more closely matches long vowels than geminate consonants. Most geminate consonants can only occur intervocalically, and thus can be attributed to ambisyllabicity[25], as shown in (7).

(7) Geminate stops and affricates in Blackfoot.

a)	iiksí**pp**atsinima	[iːkˢíˑ**pː**atˢinimaˌ]	she is curious about (s.t.)	(79)
b)	no**tt**oksííksi	[no**tː**okˢíːkˢiˌ]	my knees	(130)
c)	sooyi**kk**inssimoyiiksi	[soːjɪ**kː**ɪnsːimojiːkˢ]	poisonous plants	(218)
d)	ikkíá'yoohko**ttsí**'poyiwa	[ɪkːʲáʔjoxko**tːˢ**íʔpojiw]	she had trouble speaking	(43)
e)	i**kks**ipóóhko'siksi	[ɪ**kːˢ**ipóxkoʔsikˢ]	tin cans	(44)
f)	áaksi**nn**áápoowa	[áakˢɪ**nː**áːpoːwaˌ]	he will go east	(190)
g)	itsikínaa**mm**a	[itˢikína**mː**aˌ]	he appears weak	(101)

I have followed the tradition of Frantz (1991), Frantz & Russell (1995), Elfner (2005, 2006, 2007), and Derrick (2007, 2006) in positing geminate affricates in (7d) and (7e) rather than stop + homorganic affricate sequences. The geminates shown above never occur before, after, or between other consonants. Geminate /ss/, on the other hand, does occur before, after, and between other consonants. Any consonant can occur before geminate /ss/ except for /w/, and any consonant can occur after geminate /ss/ except for /w/, /y/, and /'/.

(8) Long /s/ in Blackfoot.

Intervocalic

a)	kiááhkao'tsisi**ss**i	[kʲáχkoːʔtˢisisɪ**sː**i]	…for you to smoke	(108)

[25] As discussed in Chapter 2, I mean by this structural ambisyllabicity, i.e., the simultaneous attachment of one segment to two syllables, as coda to one and onset to the next.

b) iimatsiiyi**ss**iwa [iːmatˢiːjɪ**sː**iw] he crouched in ambush (162)

Preconsonantal

c) i**ss**pihkima [ɪ**sː**pi̥xkimą̊] he slacked off toward it (227)

d) áísinapi**ss**tama [éːsinapɪ**sː**tamą̊] he is nailing it together badly (83)

e) nítohtoi**ss**kimaa [nítǫ̊χtɔjs**ː**kimą̊] I herded (151)

Postconsonantal

f) sooyikkin**ss**imoyiiksi [soːjɪkːɪn**sː**imojiːkˢ] poisonous plants (218)

g) kipahtaní'**ss**ini [kipą̊χtaníʔ**sː**ini̥] your cut (253)

Interconsonantal

h) ikk**ss**píísa [ɪkː**sː**píːsą̊] hit him on the head! (45)

i) iikóm**ss**pika'pssiwa [iːkóm**sː**pikaʔpsːiw] he is hard to take care of (165)

(8) shows that /ss/ has a very different distribution from all other geminates. All other geminates can only occur intervocalically, but /ss/ can appear not only between vowels (8a-b), but before (8c-e), after (8f-g), or between other consonants (8h-i). Thus /ss/ is the only geminate which can occur in any environment. This is schematically represented in (9).

(9) Possible environments for geminates in Blackfoot.

	V_V	V_C	C_V	C_C
pp	✓	×	×	×
tt	✓	×	×	×
kk	✓	×	×	×
tts	✓	×	×	×
kks	✓	×	×	×
nn	✓	×	×	×
mm	✓	×	×	×
ss	✓	✓	✓	✓

The fact that geminate /ss/ occurs before and after stops does not mean that Blackfoot certainly has syllabic /s/. However, whatever the explanation is, it involves structural markedness: the only possibilities are extremely complex syllable margins, tautosyllabic geminates, or syllabic /s/. The discussion below shows that in many ways it is most useful to analyze these sequences as having a syllabic /ss/, because positing syllabic /ss/ solves the problems of pre- and post-consonantal geminates and extreme syllable complexity that only occurs with /ss/.

3.3.3 Sonority sequencing and syllabic /s/.

I use sonority sequencing to show how the proposal of syllabic /s/ in Blackfoot can be supported by the fact that Blackfoot words violate sonority sequencing without syllabic /s/, but almost always satisfy it if we assume syllabic /s/. The apparent sonority sequencing violations in complex onsets, which were discussed in § 3.2, also provide preliminary support for the idea of syllabic /s/ in Blackfoot. As in complex onsets, many consonant clusters involving /ss/ violate sonority sequencing, but if we assume a syllabic /s/, many of these apparent violations disappear.

(10) Sonority sequencing violations without syllabic /s/.

a)	ik.**kssp**íí.sa	[ɪk**ks:p**í:sa̰]	(45)
b)	ii.kóms.**sp**i.ka**'ps**.si.wa	[i:kóm**ʔs:p**ika**ʔps:**iw]	(165)
c)	ni.to.ká**'ps**.**st**o.pi	[nitoká**ʔps:t**opḭ]	(154)
d)	ni.táaks.**st**a.mi.táóh.koo.ni.mát.tsaa.wa	[nitáak**s:t**amitɔxko:nimát:ˢa:w]	(154)
e)	ots.**st**áks.siis.tsi	[ot**s:t**ákˢsi:stˢ]	(23)

In (a), the onset of the second syllable features a fricative of higher sonority between stops of lower sonority. (b) and (c) have a complex onsets with a fricative before a stop, as well as complex codas with a fricative after a stop, both of which violate sonority sequencing. (d) and (e) have complex onsets which start with a higher sonority fricative and go on to a lower sonority stop. (10a) presents a special problem because it has two geminate consonants in a row. Because there is no way for both of these geminates to be ambisyllabic, it is unclear how moraic phonology would represent this word.

Given the proposal of inherently moraic /s/ in Blackfoot, we would expect /s/ to be able to act as a syllable nucleus. As can be seen from (10), there are advantages to positing syllabic /s/ in Blackfoot. One of these is that sonority sequencing violations are much rarer. In assuming syllabic /s/ there is the advantage of being able to unambiguously syllabify words such as those in (10). (11) shows the syllabification of these words with syllabic /s/.

(11) Sonority sequencing satisfaction with syllabic /s/.

a)	ik.kss.píí.sa	[ɪk:s:pí:sa̰]	(45)
b)	ii.kóm.ss.pi.ka'.ps.si.wa	[i:kóm**ʔ**s:pika**ʔ**ps:iw]	(165)

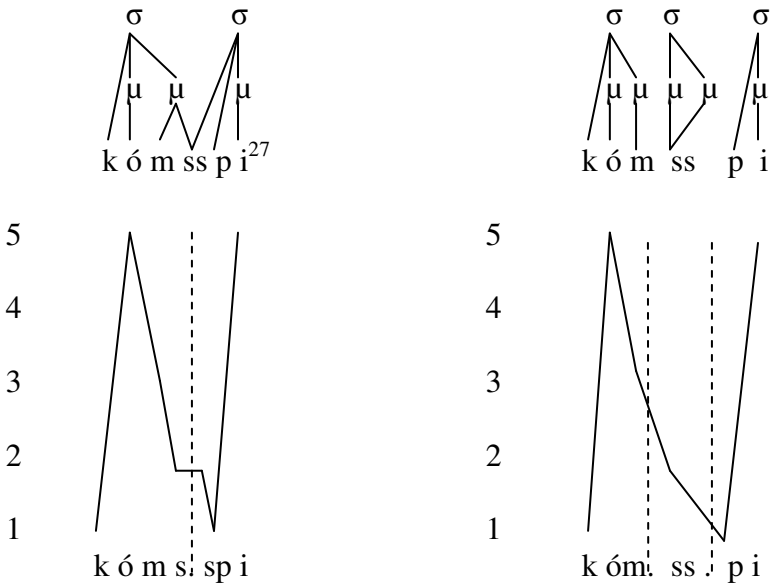
c)	ni.to.ká’.pss.to.pi	[nitoká?psːtopi̥]	(154)
d)	ni.táa.kss.ta.mi.táóh.koo.ni.mát.tsaa.wa	[nitáaksːtamitɔ́xkoːnimátːˢaːw]	(154)
e)	o.tss.táks.siis.tsi	[otsːtákˢsiːstˢ]	(23)

In (11), all the words satisfy both sonority sequencing and Vennemann’s syllable contact law, rather than having numerous violations of both as in (10).

A compelling reason to adopt syllabic /s/ in Blackfoot is that under this analysis most onsets and codas obey sonority sequencing and Vennemann’s syllable contact law. (12) and (13) show two differing analyses of the two sections with geminate /s/ in the word *iikómsspika’pssiwa*, ‘he is hard to take care of’. (a) shows analyses without syllabic /s/, while (b) is with syllabic /s/. Sonority is shown beneath each example. Vertical dotted lines represent syllable boundaries in the sonority graphs.

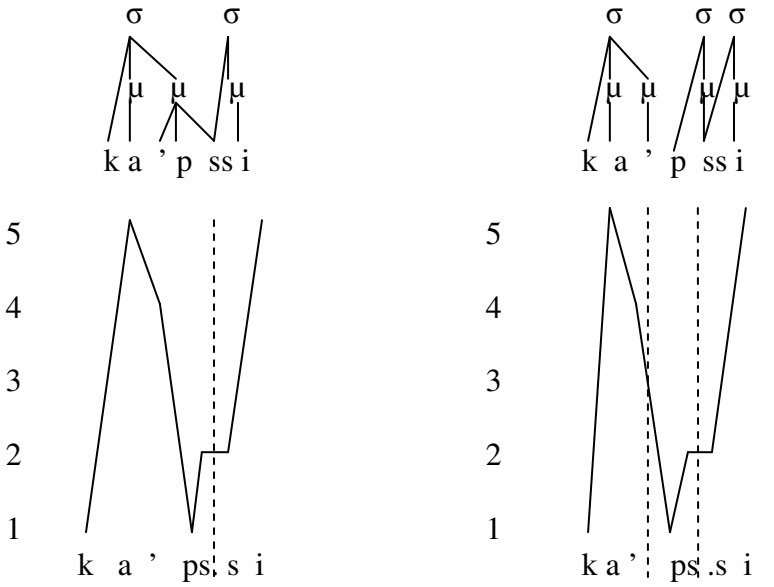
(12) …kóm(')s.spi… vs. …kóm(').ss.pi…[26]

(a) Without syllabic /s/ (b) With syllabic /s/



(13) …ka'ps.si… vs. …ka'.ps.si…

(a) Without syllabic /s/ (b) With syllabic /s/



[26] The epenthetic glottal stop between a nasal and a long /ss/ is optional.

[27] Normally an ambisyllabic segment is represented with a single symbol. I have retained the double /ss/ in these examples so that they match up with the orthographic examples presented previously.

The sequence in (12a) has a complex coda, which obeys sonority sequencing, and a complex onset, which violates it because of the fricative-stop sequence. (12a) also goes against Vennemann's syllable contact law, which says that sonority should decrease across a syllable boundary. If /ss/ is treated as two separate segments, rather than a single ambisyllabic segment, it also more specifically violates the Obligatory Contour Principle (OCP), which states that adjacent segments should not be identical, i.e., geminates should not be treated as two separate segments. This principle was first set forth for tone contours in Leben (1973) and discussed further in terms of distinctive features in Goldsmith (1976) and McCarthy (1979), among others. Because of the OCP, moraic phonology posits that geminates are a single segment attached to two syllables, rather than a sequence of two identical segments (Hayes 1989). (12b) satisfies both sonority sequencing and the syllable contact law. In (13), (a) violates sonority sequencing because of the stop-fricative sequence in the complex coda, whereas (b) has no such violation (and has no complex syllable margins). The fact that (12a) and (13a) are difficult to syllabify, and both have violations of sonority sequencing and the syllable contact law, while (12b) and (13b) satisfy both conditions, shows that it is advantageous to posit syllabic /s/ in Blackfoot. The representation in (13b) of a segment forming both a nucleus to one syllable and an onset to the next may seem surprising at first. Ambisyllabicity is generally held to be attachment to a coda and onset, not a nucleus and onset. However, I see no reason why this same analysis should not be extended to vowels. Tense vowels before onsetless syllables often are perceived as being followed by glides, e.g., hearing *nowápsspi* for *noápsspi*. This holds for many languages, not just Blackfoot. This predicts that the sequence *-io-* should be perceptually indistinguishable from the sequence *-iyo-* cross-linguistically, which seems to be the case. Though doubtless there are acoustic correlates relating to vowel height and tenseness which can distinguish these sequences,

this does not discredit the hypothesis that speakers will not be able to distinguish these sequences in the absence of other disambiguating data.

3.3.4 Root-initial syllabic /ss/.

Besides occurring before, after, and between consonants, geminate /ss/ also occurs word-initially. Since in moraic phonology onsets should not be associated with a mora, this creates a problem for how to represent these word-initial geminates. However, if we assume that these geminates are syllabic, this solves the problem of how to represent them. In this case the moraic /s/ appears in a position where it can be associated with a mora: the nucleus. While it may not directly support syllabic /s/, I believe the existence of initial [iss] ~ [ss] in many of these roots does directly support the hypothesis of moraic /s/ in Blackfoot. (14) surveys a range of [ss]-initial roots, showing the variation between [iss] and [ss].

(14) [ss] ~ [iss] alternations.

a)	**ss**aaksisttakaaki	try a shoe on for size	(220)
b)	**(i)ss**áaksisttákaakit	try the shoe on!	(220)
c)	**iss**áaksisttákaakiwa	he tried on the shoe	(220)
d)	**ss**kao'mitaoopikkini	crazy, daft	(223)
e)	**ss**kao'mitaoopikkinit	be daft!	(223)
f)	**(i)ss**káó'mitáóopikkiniwa	she was daft	(223)
g)	**ss**im	pay (a curer) for treatment	(222)
h)	**ss**imisa	pay him!	(222)
i)	**iss**imiiwa	he brought her payment	(222)

These examples are difficult to explain and to syllabify without syllabic /s/, but with syllabic /s/ they can be syllabified the same as words beginning with a long vowel. It may be that for speakers who seek to avoid initial consonant clusters or syllabic /s/, an epenthetic [i] is inserted before the /s/, which avoids an initial geminate or syllabic /s/, but remains faithful to the mora attached to the /s/, since the /s/ still appears in a weight-bearing position: the coda.

The reader may wonder if in fact it is justified to list these roots as beginning with a long /ss/ rather than /iss/, given that if epenthesis occurs in Blackfoot, this root-initial "connective-/i/" (Frantz 1991, Elfner 2005) seems to be the only case. Frantz & Russell (1995) gives the root for 'measure' as *sskskaaki*, even though in many words the root has an initial [i]. This is because not all forms have this output [i]. The first person form for 'I measure(d)'[28] is *nítsskskaaki*. It would be difficult to explain the loss of a vowel between two consonants if the root really did begin with *i-*. It is unexpected that *nítsskskaaki* does not feature any kind of morphophonemic deletion or epenthesis, especially since the first person prefix *nit-* has an allomorph *ni-* before most consonants, as in *nikííhtsípimiota'siksi*, 'my pinto horses', from *kííhtsípimiota'si*, 'pinto horse'. If, on the other hand, the /ss/ is syllabic, e.g., *ní.tss.ks.kaa.ki*, there would be no need for an /i/ to break up the consonant cluster.

The fact that the presence of initial *i-* in these roots is only occasional, combined with the fact that first and second person forms never contain an *-i-* between the person prefix and the root, suggests that the /ss/ in these roots is at least sometimes, if not always, syllabic. If [ss] can act as a syllable nucleus, there would be no reason for deletion or epenthesis, since the *-t-* of *nit-* would form the onset of a syllable with *-ss-* as the nucleus. The optional, or in some cases obligatorily absent, *i-* means that either these words contain a syllable-initial geminate,

[28] Blackfoot has no formal way of marking past, so many verb forms can be interpreted as past or present depending on context. In general, zero marking receives a past interpretation, while the "durative" receives a present interpretation. See Dunham (2007).

something that is at the very least highly marked since they occur in few if any languages (Davis 1999, Hume et al. 1997), or a syllabic /s/.

3.4 Conclusions

This chapter has considered evidence for the proposal of an inherently moraic /s/ in Blackfoot. This assumption has several advantages. The first is that positing moraic /s/ in all situations removes the burden of explanation from syllabic /s/ and geminate /s/. If /s/ is inherently associated with a mora, it should be able to occupy nucleus position, just as vowels do. This predicts that it should be possible to have a syllable with /s/ as an onset and as a syllable nucleus. Don Frantz (p.c.) reports that this does seem to be the case in *áyaahsssikópiwa*, 'he likes to rest', which "really sounds like [á.yah.sss.si.kó.pi:w]". The theory of moraic /s/ can also be used to explain how /s/ can participate in complex syllable margins. If /s/ is moraic, it can be parsed to a higher prosodic node without necessarily being more marked.

The proposal of moraic /s/ would be strengthened by examining other languages to see if such a proposal would be valuable in any other language, either for /s/, which often acts differently from other phonemes, or for any other segment. § 3.2 showed that this type of moraic segment can more readily be extrasyllabic, and that the distribution of word-initial complex clusters in Blackfoot is in some ways similar to some dialects of Arabic, as outlined in Kiparsky (2003). (15) summarizes the surface realizations of moraic /s/.

(15) Underlying and surface realizations of moraic /s/.

a) /s_{μ}/

i.	Extrasyllabic:	<**s**>tsi.ki	another	(232)
ii.	Ambisyllabic:	ii.ma.tsii.yi**s**.**s**i.wa	he crouched in ambush	(162)
iii.	Syllabic:	ki.pah.ta.ní'.**s**.si.ni	your cut	(253)
iv.	Non-moraic:	**s**a.'áí	duck	(206)

b) /$s_{\mu\mu}$/

i.	Syllabic:	ii.kóm.**ss**.pi.ka'.ps.si.wa	he's a burden	(165)

(15a) shows monomoraic /s/ with four surface realizations: (i) extrasyllabic short /s/, (ii) ambisyllabic geminate /ss/, (iii) syllabic /s/ forming a syllable nucleus and onset to the following syllable, and (iv) non-moraic onset /s/. (15b) shows bimoraic /s/ surfacing as a long syllable nucleus between two consonants. In (15a) the initial moraic /s/ in *stsiki* is parsed as extrasyllabic, in order to avoid a complex onset. In (15b) the /s/ in ambisyllabic, just as are other geminates, forming the moraic coda to the first syllable and the non-moraic onset to the next. In (15c) the /s/ is syllabic, forming the nucleus of the fifth syllable, as well as being the non-moraic onset of the sixth syllable. In (15d) /s/ is the non-moraic onset to the first syllable. (15e) shows /s/ attached to two moras, just as long vowels, where long /ss/ is acting as a syllable nucleus.

Because an inherently moraic segment should be able to act as a syllable nucleus, this chapter discussed evidence for syllabic /s/ in Blackfoot. Proposing a moraic /s/ predicts that /s/ should be syllabic in Blackfoot, and § 3.3 presented evidence that this is the case. Mizuki Miyashita (p.c.) reports that her Blackfoot speaking consultant writes consonant-bounded geminate /ss/ separately when breaking down words to teach pronunciation to children at the

Blackfoot immersion school in Browning, MT. While this does not mean that Blackfoot has a syllabic /s/, it does show that /s/ is in some way a separate prosodic unit. There are pitfalls to native speaker intuitions; for certain languages, e.g., Japanese, the basic rhythmic unit is the mora rather than the syllable (Cole & Miyashita 2006). Enrico (1991) notes that in his research on Haida, "naïve speaker syllabification is not entirely consistent and not always easily obtained" (Enrico 1991:98). There seems to be a gap in the literature regarding the elicitation of syllable structure. Fitzgerald (1997) and Hayes (1995) discuss how to use the tapping or clapping methods for determining stress placement, but there is no corresponding method for determining syllable boundary placement, e.g., *a.sta* vs. *as.ta*. Likewise, it is not even certain that these types of methodologies will work for non-stress languages like Blackfoot. Since non-stress languages do not have the same type of syllable prominence, the clapping method may not elicit any type of reliable native speaker judgment. Because of this, theoretical generalizations based on cross-linguistic markedness are preferable in syllabifying words in non-stress languages.

/ss/ is in some way very different from other phonemes at the prosodic level, as shown by the various methods native speakers use to syllabify such clusters, which seem to defy all normal attempts at syllabification. While more research needs to be done, there seems to be no data from native speakers that directly contradicts the notion of syllabic /s/ in Blackfoot. Positing a moraic /s/ in Blackfoot explains several of the peculiarities of the phoneme, and seems to be a useful analysis for the purposes of Blackfoot syllabification. If /s/ does indeed act like a vowel, then long /ss/ can be explained by association with two moras, receiving extra length in the same manner as a vowel rather than other geminates. This removes the need to find a way for every geminate /ss/ to be ambisyllabic. While intervocalic geminate /ss/ can be treated the same as other geminates, interconsonantal geminate /ss/ can only be syllabified when it is treated as a

vowel, especially when it comes before or after other geminates. The next chapter offers an analysis of moraic /s/ in Optimality Theory, including an analysis of extrasyllabic /s/ and an analysis of syllabic /s/.

CHAPTER 4: OT ANALYSIS OF /S/ IN BLACKFOOT

4.1 Introduction

This chapter offers an OT analysis of the generalizations set forth in Chapter 3. § 4.2 looks at extrasyllabic /s/ in OT, while § 4.3 examines syllabic /s/. § 4.4 gives a summary and conclusions.

4.2 Extrasyllabic /s/ in OT

In 3.2 I proposed that positing moraic /s/ reduces the markedness of complex onsets involving /s/ because a moraic /s/ can more easily be extrasyllabic. I stress again that some explanation for complex syllable margins in Blackfoot is necessary because complex clusters in Blackfoot only exist if they involve /s/ or /ss/. By positing extrasyllabicity for word initial /s/ in complex onsets, the "complex" onsets do not actually violate *COMPLEX, since at the syllabic level they are simple.

4.2.1 Exhaustivity

To show that extrasyllabicity is relevant to the theory of moraic /s/ in Blackfoot, I appeal to Selkirk's (1995) EXHAUSTIVITY, rephrased slightly from the original version.

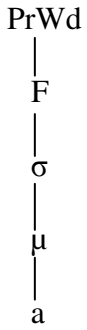
(16) **EXH(AUSTIVITY)**: No prosodic category immediately dominates a constituent more than one level below it.[29]

[29] When constraints are introduced, the full forms are given with parenthesis around material that is omitted in tableaux for spatial economy, e.g., PR(OSODIC)SEQ(UENCING) will in general be written as PRSEQ.

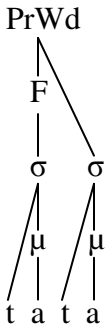
Because this constraint does not reference a specific level of structure, a form may violate or satisfy different levels of exhaustivity, e.g., EXH(σ), in which the syllable would be dominating a constituent more than one level below it, or EXH(PrWd), where the prosodic word would be dominating a constituent more than one level below it (Selkirk 1995). (1) illustrates the satisfaction and violation of EXH, specifically EXH(PrWd), at the level of the prosodic word.

(1) Satisfaction and violation of EXH.

(a) Satisfaction



(b) Violation

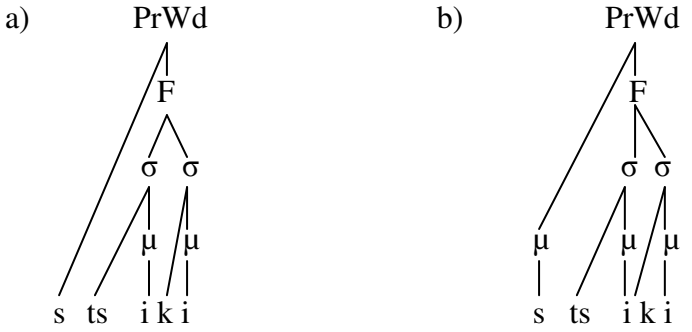


In (1a), there are no EXHAUSTIVITY violations because each prosodic category dominates a constituent that is directly beneath it: the prosodic word dominates a foot, the foot dominates a syllable, the syllable dominates a mora, and the mora dominates a segment. (1b) contains one violation of EXH(PrWd), because the prosodic word dominates an unfooted syllable, and two violations of EXH(σ), because the onsets of both syllables are parsed directly to the syllable node without an intervening mora, which means that the syllable nodes dominate constituents that are two levels below them.

While the concept of exhaustivity entered into linguistics with relevance to stress assignment (Kager 2001), it is also relevant to the issue of extrasyllabic moraic segments. The

EXHAUSTIVITY constraint indicates that an extrasyllabic moraic segment will be less marked than an extrasyllabic non-moraic segment, which supports the analysis of extrasyllabic moraic /s/ in Blackfoot. Because of this constraint, an extrasyllabic consonant will incur a violation, because it will be parsed to a prosodic category multiple levels above it. However, violations of EXH do occur: an onset segment parsed directly to the syllable rather than to a mora will violate EXH(σ), because the syllable will be dominating a constituent that is more than one level below it, the mora level being the level directly below the level of the syllable. In the case of an extrasyllabic segment parsed to the prosodic word, the prosodic word is four levels above the segment level, with mora, syllable, and foot intervening between. However, if the segment is moraic, this means that it is parsed to a mora, and the mora is parsed to the prosodic word in the case of an extrasyllabic moraic segment. The addition of the mora level makes the extrasyllabicity less marked, since the moraic segment only has the syllable and foot between it and the prosodic word. This means that an extrasyllabic moraic segment should *ceteris paribus* be less marked than a non-moraic extrasyllabic segment. (2) illustrates this graphically.

(2) Prosodic structure for (a) non-moraic and (b) moraic extrasyllabic /s/.



In (2) the dominating category is the prosodic word. In (a) the dominated category is the segment, while in (b) it is the mora. (a) shows a segment parsed to a prosodic word, which is four levels above it. In (b), on the other hand, where the moraic segment's mora is parsed to the prosodic word, the dominating category is only three levels higher. The parsing of a non-moraic segment in (a) is the type of extrasyllabicity found in English, while the parsing of a moraic segment in (b) is the type found in Blackfoot. In this way the parsing of a moraic segment to the prosodic word is less marked than parsing a non-moraic segment to a prosodic word. As mentioned in § 3.2.1, this parallels Kiparsky's (2003) analysis of initial complex clusters in some dialects of Arabic. This type of extrasyllabicity prevents complex margins at the syllabic level. (3) show the ranking of *COMPLEX and EXH(PrWd) in Blackfoot.

(3) Ranking of *COMPLEX and EXH(PrWd).

*COMPLEX >> EXH(PrWd)

This ranking predicts that extrasyllabic segments attached directly to the prosodic word will always be preferred to complex syllable margins. Since extrasyllabicity is more common at word edges (Green 2003), this ranking may need to be revised for word-medial complex syllable margins, but explains word-initial complex onsets in Blackfoot. (4) gives a tableau for the EXH(PrWd) violation represented in (2b), which represents the optimal type of extrasyllabicity, both because the /s/ retains its mora, and because this mora reduces the markedness of the extrasyllabic segment. This type of gradient markedness, with an extrasyllabic moraic segment representing a less severe violation of EXH(PrWd) than an extrasyllabic non-moraic segment, is an area which requires future research.

(4) Tableau for *stsiki*, 'another'

	/$s_\mu$tsi$_\mu$ki$_\mu$/	*COMPLEX	EXH(PrWd)
a)	$s_\mu$tsi$_\mu$.ki$_\mu$	*!	
☞ b)	<s_μ>tsi$_\mu$.ki$_\mu$		*

Candidate (a) contains a complex onset, and so is disqualified by *COMPLEX. Candidate (b) emerges as the optimal candidate, even though it incurs a violation of EXH because of its extrasyllabic segment. As in all situations of markedness, however, elements or features are not simply marked or unmarked; there are varying degrees of markedness. A syllable node directly dominating a segment is marked, while a foot directly dominating a segment is more marked, and a prosodic word directly dominating a segment is even more marked. Since a syllable is two levels above the segment level, a syllable directly dominating a segment violates EXHAUSTIVITY. Since onsets are not moraic, there must be some other markedness constraint more highly ranked than EXH which prefers non-moraic onsets even though they violate exhausitivity.

4.2.2 Prosodic sequencing

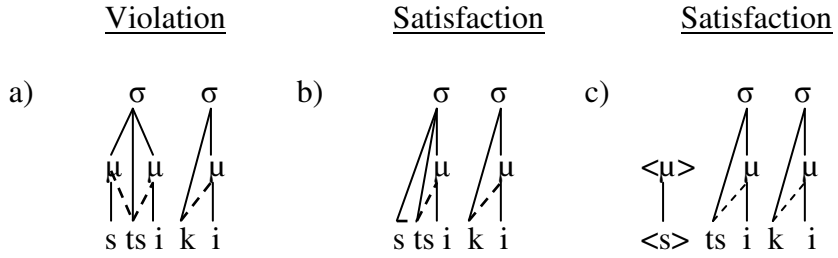
As mentioned above, EXH violations seem to be tolerated more at category edges, e.g., extrasyllabic consonants are more marked word-internally than at word edges (Green 2003). To take into account this generalization I propose the PROSODICSEQUENCING constraint, which militates against having lower-level prosodic categories parsed between higher-level prosodic categories.

(5) PR(OSODIC)SEQ(UENCING): The level of a dominated prosodic category must increase toward the perceptual center of a dominating category.[30]

While for the purposes of this thesis this constraint is most relevant for prohibiting moraic onsets, it also predicts that codas will be non-moraic, and thus that moraic codas are more marked than non-moraic codas. This would be supported if it turns out that more languages count CVC syllables as light than heavy. Most likely some future revision will be necessary, because even if it is true that codas are more commonly non-moraic, the fact remains that moraic codas are less marked than moraic onsets, and as currently stated the PROSODICSEQUENCING constraint does not account for this difference. The PROSODICSEQUENCING constraint also predicts that complex syllable margins will be marked, since when two non-moraic or two moraic segments are attached to the same node, the level of the dominated category, in this case the segment, stays the same rather than rising. However, it is assumed in this thesis that a candidate with the dominated category decreasing when it should be increasing will be more marked than a candidate with the dominated category remaining at the same level when it should be increasing, and thus I will only mark a violation for onsets with the dominated category decreasing. This again illustrates the need to account for markedness gradience within OT: *stsi-* and s_{μ}*tsi-* both violate , but s_{μ}*tsi-* does so more severely. (6) shows the prosodic structure for *stsiki*, 'another', showing the difference between a moraic and non-moraic onset /s/. The dotted lines track the level of the dominated category for each syllable. The relevant contrast occurs in the first syllable.

[30] De Jong (1994:447) defines a perceptual center as "the point in time that subjects use to align syllables in a regular rhythm." This is a necessary distinction from the actual "center" of the syllable, since in a syllable such as *stsi* the center is /ts/, but the perceptual center is /i/, and it is this perceptual center which is relevant for processes such as prosodic sequencing.

(6) Violation and satisfaction of prosodic sequencing.



In (6a) the segment /s/ is moraic, but the segment /ts/ is non-moraic, which means that the level of the dominated category goes down before rising back to the mora level at the syllable nucleus. In (6b) the level of the dominated category increases towards the nucleus, satisfying prosodic sequencing, but violates mora preservation because the /s/ is no longer associated with a mora. (6c) satisfies both prosodic sequencing and mora preservation by having an extrasyllabic /s/ which retains its mora but does not participate in prosodic sequencing at the syllabic level. The PROSODICSEQUENCING constraint would explain the tendency for onsets to be non-moraic: by parsing onsets directly to the syllable, the level of the dominated category increases towards the center of the syllable because the left edge is a segment (two levels below the syllable), while the nucleus is attached to a mora (one level below the syllable).

Here I have attempted to provide a reason for the extant *ONS-μ constraint (see Kager 2001), which is certainly relevant, but lacks an explanation of why moraic onsets are marked. If PROSODICSEQUENCING proves to be a motivated cross-linguistic constraint, it may also explain the existence of languages that count CVC syllables as light for purposes of stress assignment: the syllable nucleus is a higher prosodic category while both edges are lower. This type of sequencing parallels sonority sequencing, in which the sonority of segments should increase towards the center of a syllable; indeed, the PRSEQ constraint is essentially this idea applied to

prosodic categorization. The constraint also makes a prediction: that moraic codas are more marked than non-moraic codas, because only in the case of a non-moraic coda does the dominated category decrease from the syllable nucleus, from moraic to non-moraic. Since moraic onsets are more marked than moraic codas, it may be relevant that the existence of onsets is unmarked while their attachment to a mora is marked, and on the other hand that the existence of codas is marked while their attachment to a mora may be unmarked, or at the very least less marked than the attachment of an onset to a mora.

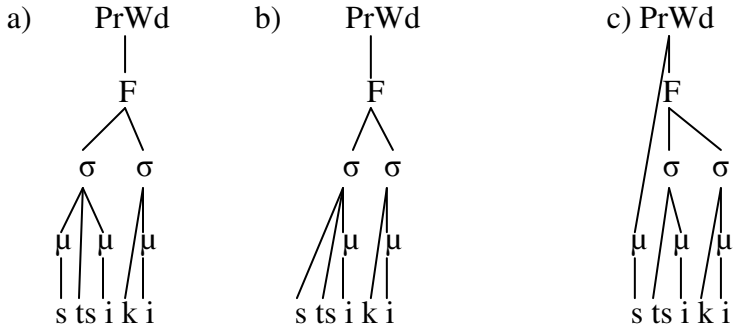
The PRSEQ constraint must be ranked above EXH(PrWd), because otherwise moraic onsets would be preferred to extrasyllabic moraic segments. The other possibility for an input with a moraic onset, which violates PRSEQ, is the loss of the associated mora, which would result in a candidate that satisfies PRSEQ but violates MAX-μ. Since this is not the case, MAX-μ must also be ranked above EXH(PrWd). This ranking is given in (7).

(7) Ranking of MAX-μ, PRSEQ, and EXH(PrWd).

MAX-μ, PRSEQ >> EXH(PrWd)

An example of underlying moraic /s/ is given in (8) for the word *stsiki*, 'another'; a tableau is given in (9). Syllable boundaries are marked with a period, while an extrasyllabic segment is enclosed in angled brackets (<>).

(8) Prosodic structures for candidates in (9).



(9) Tableau for *stsiki*, 'another'

	/s_{μ}tsi_{μ}ki_{μ}/	MAX-μ	PRSEQ	EXH(PrWd)
a)	(stsi_{μ}.ki_{μ})	*!		
b)	(s_{μ}tsi_{μ}.ki_{μ})		*!	
☞c)	<s_{μ}>(tsi_{μ}.ki_{μ})			*

Candidate (a) is eliminated because of a MAX-μ violation, since the mora attached to the initial /s/ is not preserved. Candidate (b) violates PRSEQ because the prosodic level dominated by the syllable goes down and then up: from the mora, down to the segment level, then back up to the mora level. Winning candidate (c) suffers an EXH(PrWd) violation because of its extrasyllabic /s/, which bypasses the syllable and foot nodes and is parsed directly to the prosodic word, but this is not enough to disqualify it. Perhaps crucially, even though the /s/ is violating exhaustivity, it satisfies prosodic sequencing, as opposed to, e.g., a foot-medial extrasyllabic consonant. A foot-medial extrasyllabic consonant would violate prosodic sequencing because at either edge of the foot the dominated category would be the syllable, while medially the dominated category would be the segment. This decrease in the level of the dominated category is exactly what is prohibited by prosodic sequencing.

The PRSEQ constraint attempts to account for the fact that onsets should not be moraic, while nuclei should be moraic. It also provides a reason for the extrasyllabicity of /s/, but not other consonants. This constraint predicts that non-moraic codas will be less marked than moraic ones, i.e., more languages should count CVC syllables as light than heavy.

4.3 Syllabic /ss/ in OT

§ 3.2 proposed that /s/ is always moraic in Blackfoot[31], which predicts that /s/ should be able to act as a syllable nucleus. § 3.3 surveyed evidence that Blackfoot does have a syllabic /s/, including the difficulty in syllabifying Blackfoot words without this assumption. Another difficulty without assuming syllabic /s/ is that there would exist nasal-fricative clusters that violate cross-linguistic well-formedness constraints. As Elfner (2005) mentions, Blackfoot has highly restrictive, and because of this it would be unusual for Blackfoot, which does not even allow the cross-linguistically well-formed onset *sn-*, to allow the extremely marked coda *-ns*. Goldsmith (1990) makes the universal claim that in any given language, codas will be a subset of onsets. In the case of complex syllable margins we must take into account sonority sequencing, so that if a language has a coda *-ns* we would not expect that the language will also have the onset *ns-*, but rather that the language will have the onset *sn-*, e.g., English has the coda *-ns* in "trance", and also the onset *sn-* in "snack". In Blackfoot this is not the case, so it is worthwhile to look for some other explanation for these *-nss-* clusters in Blackfoot. (10) shows a selection of [Ns:] sequences in Blackfoot, where /N/ represents any nasal, i.e., /m/ or /n/.

[31] It is the inherent moraicity of /s/ in Blackfoot which predicts its ability to act as a syllable nucleus. Coda consonants, though often moraic because of Weight-by-Position, are not expected to act as nuclei.

(10) *-Nss-* clusters in Blackfoot.

a) otáí'**nss**i	[otéjʔ**nsː**i]	…when he died	(229)
b) iikó**mss**pika'pssiwa	[iːkó**mʔsː**pikaʔpsːiw]	he's a burden	(165)
c) sooyikki**nss**imoyiiksi	[soːjɪkːɪ**nsː**imojiːkˢ]	poisonous plants	(218)

Without syllabic /s/, all of these words would have syllables ending with *-Ns*, a coda that does not have a corresponding onset, violating Goldsmith's (1990) universal claim. Furthermore, Goldsmith notes that even in languages like English that allow onsets and codas of three to four segments, this type of syllable markedness usually occurs only across morphological boundaries. Thus in a language such as Blackfoot, which allows much less syllable complexity, it would be unexpected to find a *-ms* coda within a root, where it cannot be separated by any kind of prosodic or morphological boundary. The proposal of syllabic /s/ reanalyzes these clusters so that the geminate /ss/ in (10) forms a syllable nucleus, rather than being an ambisyllabic geminate, which explains this apparent exception to Goldsmith's universal.

The existence of nasal + voiceless obstruent clusters is marked (Kager 2001, Hayes & Stivers 2000, Pater 1999, McCarthy & Prince 1995, Itô & Mester 1986, Justeson & Stephens 1981, Drachman & Malikouti-Drachman 1973), but as I have proposed, it is inaccurate to think of clusters as simply "marked" or "unmarked"; clusters such as these are more or less marked depending on how closely aligned they are in the prosodic hierarchy. Herok & Tonelli (1979) consider the example of nasal assimilation in Italian and German across increasingly high prosodic levels. If there is a boundary between the NC cluster, the cluster is less marked the higher the boundary is, as demonstrated by Herok & Tonelli's illustration that nasal assimilation before stops becomes more obligatory the lower on the prosodic hierarchy the boundary is. At

morpheme boundaries, assimilation is required even in formal speech, whereas at clitic/word boundaries it is required only in casual speech, and between two stressed words it is possible in casual speech but never required (Herok & Tonelli 1979:48).

In terms of markedness, ill-formed clusters will be least marked when the prosodic division between them is highest, e.g., when the segments belong to different prosodic words, and most marked when the prosodic division between them is the lowest, e.g., if the segments belong to the same syllable or even the same mora. I represent this graphically in (11). (## represents a prosodic word boundary, # represents a clitic boundary, + represents a morpheme boundary, . represents a syllable boundary.)

(11) Ranking of NÇ clusters.

*N##Ç̥ >> *N#Ç̥ >> *N+Ç̥ >> *N.Ç̥ >> *(NÇ̥)$_{\mu}$

least marked ◄——————————► most marked

(11) shows that ill-formed clusters are more marked the lower the prosodic boundary separating them, with clusters across prosodic word boundaries being the least marked and tautosyllabic clusters, most specifically those attached to the same mora, i.e., in a complex coda, being the most marked. It is this last, most highly marked, context in which we find /Ns/ sequences in Blackfoot, at least without the assumption of syllabic /s/.

Many authors have noted processes by which languages alter NÇ̥ clusters. In more recent years, this has been formulated as the constraint *NÇ̥ (Pater 1999).

(12) *NÇ̥: No nasal/voiceless obstruent sequences.

However, as discussed in this section, not all NC̥ clusters are equally marked, with the most marked context being tautosyllabic NC̥ clusters. To capture this generalization, I will propose the constraint *NC̥]$_\sigma$.

(13) ***NC̥]$_\sigma$**: Nasals and voiceless obstruents should not be attached to the same mora. [32]

This constraint is similar to the *NC̥ constraint, but takes into account that these clusters are more marked the lower the prosodic category by which they are dominated. Thus we would expect that the universal ranking of these two constraints would be *NC̥]$_\sigma$ >> *N.C̥, because nasal-voiceless obstruent clusters are less marked if they are separated by a syllable boundary.

Languages use several different strategies for reducing the markedness of such clusters, as outlined in Kager (2001). One of these is deletion of one or the other segment, so that instead of an NC sequence, only the N or the C is left. Another is coalescence, in which the features of both segments merge to form a single segment, as in Indonesian (Halle & Clements 1984). Voicing assimilation is also common, where a voiceless stop or fricative becomes voiced after a nasal. Blackfoot does not employ any of these strategies for reducing the markedness of these clusters. Neither the nasal nor the /s/ is ever deleted, and Blackfoot has no voiced obstruents, which means the /s/ is never voiced. Because Blackfoot does not use any of these phonological or phonetic strategies, it stands to reason that some prosodic factor may be reducing the markedness, especially since Blackfoot does not have the less marked nasal-stop clusters.

[32] The reader may note that NC]$_\sigma$ and (NC)$_\mu$ are not *a priori* identical. It is theoretically possible to have a nasal which is attached directly to the syllable node followed by a final /s/ attached to a mora. I do not consider this possibility in the following discussion for the sake of simplicity, since this type of structure would be eliminated by the PRSEQ constraint.

The nonexistence -NC̨ codas except before geminate /ss/ in Blackfoot suggests that the long /s/ clusters in (10) should be syllabified in some other way. (10) is repeated here as (14).

(14) *-Nss-* clusters in Blackfoot.

a) otáí'**nss**i	[otɛ́jʔ**nsː**i]	…when he died	(229)
b) iikó**mss**pika'pssiwa	[iːkó**mʔsː**pikaʔpsːiw]	he's a burden	(165)
c) sooyikki**nss**imoyiiksi	[soːjɪkːɪ**nsː**imojiːkˢ]	poisonous plants	(218)

Syllabifying these clusters as a nasal coda preceding a syllabic /ss/, eliminates highly marked codas and complex syllable margins. The syllabification of the nasal to the coda of the preceding syllable is supported by the occasional epenthesis of a glottal stop between the nasal and the geminate /ss/. Since /'/ almost always appears in coda position, this suggests that the nasal, too, must be a coda. This is a case where it may not be as relevant to talk about the emergence of the unmarked (McCarthy & Prince 1993) as the emergence of the less marked. This reiterates the point that gradience needs to be accounted for, since in many cases not all violations of a certain constraint are equally marked. Certainly a syllabic /s/ is marked, but I believe that, for the reasons outlined in this thesis, in Blackfoot it is less marked than certain other aspects of syllable complexity and structural markedness. (15) lists several examples of -CssC- clusters in Blackfoot that support the proposal of syllabic /s/.

(15) -CssC- clusters in Blackfoot.

a) a.wóí**'.ss.t**aaks.sin	cross	(16)
b) sáóh.pa.po.kai**'.ss.t**oot	air it outside!	(200)

c)	ó.mah.**kss**.**k**s.sii.naa.wa	big insect	(86)
d)	ii.kó**m**.**ss**.**p**i.ka'.ps.si.wa	he is hard to take care of	(165)
e)	ik.**kss**.**p**íí.sa	hit him on the head!	(45)
f)	is.spa**y**.**ss**.**t**oo	mule deer	(87)
g)	is.s**tss**.**k**áán	dust	(88)
h)	ní.**tssks**.kaa.ki	I measured	(225)
i)	o**m**.**ss**.**t**a.ki	steal a portion/share of	(165)
j)	no.á.**pss**.**p**i	my eye	(128)

As shown in (15), -CssC- clusters in Blackfoot occur with some regularity, and occasionally occur as part of an even longer cluster, such as in the -CCssCss- cluster in (c). Since words such as those in (15a-c) would not be disqualified by the *NC̥]$_{\sigma}$ constraint, other well-formedness constraints are necessary to arrive at syllabifications with syllabic /ss/. A full account of syllabic /ss/ in all possible situations is beyond the scope of this thesis, but sonority sequencing and markedness constraints on syllable complexity would surely play a role in such an analysis. I believe that instances of *-kssC-* and *-tssC-* are better analyzed as, e.g., /tssC/ rather than /t^{s}sC/, since they have the same distribution as *-'ssC-*, *-hssC-*, *-NssC-* clusters, etc. However, it may be possible to analyze some clusters as *-k^{s}sC-* or *-t^{s}sC-* and because the disqualification of candidates involving these codas uses different constraints than the disqualification of codas involving nasals, the example tableau in (16) focuses on the geminate /ss/ in the root *omsstaki*, 'steal a portion/share of (e.g., food, money, etc.)'.[33] Syllable nuclei are bolded.

[33] I have assumed here a Weight-by-Position rule for Blackfoot whereby coda consonants are assigned a mora if they are not associated with an underlying mora (Hayes 1989). However, whether or not this is the case is irrelevant to the constraint rankings in (16).

(16) Tableau for *omsstaki*, 'steal a portion/share of (e.g., food, money, etc.)'

/$o_{\mu}ms_{\mu\mu}ta_{\mu}ki_{\mu}$/	*NC]$_{\sigma}$	MAX-μ	PRSEQ	*COMPLEX	NOCODA
a) **o_{μ}**$ms_{\mu\mu}$.**ta_{μ}**.**ki_{μ}**	*!			*	*
b) **o_{μ}**m_{μ}.st**a_{μ}**.**ki_{μ}**		**		*!	*
c) **o_{μ}**m_{μ}.$s_{\mu\mu}$**ta_{μ}**.**ki_{μ}**			**	*!	*
☞ d) **o_{μ}**m_{μ}.**$s_{\mu\mu}$**.**ta_{μ}**.**ki_{μ}**			*		*

(16a-c) show possible syllabifications without syllabic /s/, while (16d) shows an analysis with syllabic /s/. Candidate (a) is disqualified because of the markedness of the first coda. Candidate (a) also violates *COMPLEX because it contains a complex coda in the first syllable. Candidate (b) is eliminated because it violates MAX-μ in addition to *COMPLEX and NOCODA. Candidate (c) is disqualified because it violates PRSEQ twice as well as *COMPLEX and NOCODA. Candidate (d), on the other hand, contains no complex syllable margins whatsoever, and so is the optimal candidate. While it is uncertain whether VNssC sequences should be syllabified as V.Nss.C or VN.ss.C, i.e., whether it is more marked for a syllable to have a coda, or to have a syllable with an onset of higher sonority than its nucleus, the presence of an optional epenthetic glottal stop between the nasal and the geminate /ss/ suggests that VN.ss.C is the correct syllabification.

4.4 Conclusions

This chapter has presented OT analyses of several peculiar distributions of /s/. Proposing extrasyllabicity to /s/ would explain why it is the only consonant that can participate in complex onsets. If moraic /s/ is parsed to a higher level than the syllable (e.g., the prosodic word), this would mean that complex syllable margins would not exist at the syllabic level (Rosenthall &

Van der Hulst 1999). It also appears that several constraints, including *NC̥]$_\sigma$ and *COMPLEX, suggest the Blackfoot has syllabic /s/.

(17) and (18) below give further examples of constraint interaction in Blackfoot. One remaining question is whether it is possible to account for non-moraic onset /s/ if we accept the proposal in Chapter 3 that /s/ is always moraic. While further research needs to be done, (17) shows that it may in fact be possible to derive the contrast between moraic /s/ and Hayes's (1989) moraic geminates. In the input for (17), both /s/s are associated with an underlying mora as per the proposal of moraic /s/ in Blackfoot, just as all vowels are. The /m/s are associated with underlying moras because they are geminates. I have once again assumed a Weight-by-Position process whereby coda consonants are assigned a mora.

(17) Tableau for *saómmitsiki'sommiksi*, 'deceiving moons'

	/$s_\mu a_\mu ó_\mu m_\mu i_\mu t^s i_\mu ki_\mu$'$s_\mu o_\mu m_\mu i_\mu k^s i_\mu$/	MAX-μ	PRSEQ	*COMPLEX	NOCODA	ONSET
a)	$s_\mu a_\mu.ó_\mu.m_\mu i_\mu.t^s i_\mu.ki_\mu$'$_\mu.s_\mu o_\mu.m_\mu i_\mu.k^s i_\mu$		***!*		*	*
b)	$sa_\mu.ó_\mu.mi_\mu.t^s i_\mu.ki_\mu$'$_\mu.so_\mu.mi_\mu.k^s i_\mu$	***!*			*	*
c)	$sa_\mu.ó_\mu m_\mu.i_\mu.t^s i_\mu.ki_\mu$'$s_\mu.o_\mu m_\mu.i_\mu.k^s i_\mu$	*		*	***	**!**
☞ d)	$sa_\mu.ó_\mu m_\mu.mi_\mu.t^s i_\mu.ki_\mu$'$_\mu.so_\mu m_\mu.mi_\mu.k^s i_\mu$	**			***	*

Candidate (a) is eliminated because of its syllable-initial geminate /m/s and initial moraic /s/s, which violate PRSEQ. Candidate (b) is eliminated because is deletes all moras attached to consonants. While candidates (c) and (d) have equal violations of higher ranked constraints, (d) is the optimal candidate because it has fewer onsetless syllables. Since /s/ has a similar distribution to vowels in Blackfoot, especially in the ability of /ss/ to occur between consonants, a property it shares with vowels but not other geminates, it seems likely that the non-moraic

onset /s/ in (17b-d) is equivalent to /w/ or /j/: the non-moraic equivalent of an inherently moraic segment.

In moraic theory, vowels are inherently attached to one mora, and long vowels arise from attachment to a second mora, while consonants are not inherently attached to a mora, and geminate consonants arise from attachment to one mora. Since this thesis has proposed that /s/ is inherently moraic, just like vowels, we should expect geminate /ss/ to be attached to two moras, as in (18).

(18) Tableau for *ssksikoyoot*, 'recite (s.t.)!'

	/$s_{\mu\mu}k^{s}i_{\mu}ko_{\mu}yo_{\mu\mu}t$	PRSEQ	MAX-μ
a)	$s_{\mu\mu}k^{s}i_{\mu}.ko_{\mu}.yo_{\mu\mu}t_{\mu}$	*!	
b)	$sk^{s}i_{\mu}.ko_{\mu}.yo_{\mu\mu}t_{\mu}$		*!*
☞ c)	$s_{\mu\mu}.k^{s}i_{\mu}.ko_{\mu}.yo_{\mu\mu}t_{\mu}$		

Candidate (a) is disqualified because its initial geminate violates PRSEQ. Candidate (b) is disqualified because it does not preserve the moras associated with the /s/, violating MAX-μ. This makes (c) the optimal candidate, since it does not violate either constraint. The task of accounting for the distribution of /s/ in Blackfoot still requires further research, but as outlined in this chapter, initial results show that it is possible to account for several peculiarities of /s/ within the framework of Optimality Theory by positing that /s/ is inherently associated with a mora. (19) gives the overall ranking of constraints developed in this chapter.

(19) Overall ranking of constraints.

*NÇ]$_{\sigma}$ >> PRSEQ, *COMPLEX, MAX-μ, NOCODA >> EXH, ONSET

CHAPTER 5: CONCLUSION

5.1 Summary

This thesis has explored several peculiarities of the phoneme /s/ in Blackfoot. Chapter 1 presented some basic information about the Blackfoot language, including the phonological inventory and a brief survey of segment distribution and syllable structure. Chapter 1 also laid out the significance of this thesis, viz., a description of the distribution of /s/, how this distribution differs from that of other phonemes, and an analysis of how /s/ is different. Chapter 2 presented an introduction to Moraic Phonology and Optimality Theory, the two primary theoretical frameworks used in this thesis. Some basic markedness and faithfulness constraints were introduced, including ONSET, NOCODA, *COMPLEX, MAX-IO, and DEP-IO. I suggested that McCarthy's (1993) FINALC constraint is one that is highly relevant for Blackfoot. One assumption I have commented on numerous times throughout this thesis is the idea that constraints are merely violated or satisfied. Already inherent in OT is a way for dealing with one type of gradience. This is by articulating specific sets of constraints for different contexts, such as ranking root faithfulness above affix faithfulness, or ranking the avoidance of NC clusters within a syllable above the avoidance of NC clusters across a word boundary. However, still lacking is an account of how to explain the variability of natural speech, i.e., the fact that speakers do not produce identical forms in every token, even across identical contexts. This is a much more difficult issue to deal with, and one which is outside the scope of this thesis.

Chapter 3 presented the main claim of this thesis: that /s/ in Blackfoot is always associated with a mora. The sections of Chapter 3 showed how this assumption explains many complex issues in Blackfoot phonology. The possibility of extrasyllabic /s/ was discussed, as

well as how moraic /s/ makes that extrasyllabicity less marked than if /s/ were not tied to a mora. This extrasyllabicity means that complex onsets involving /s/ are not actually complex at the syllabic level. Sonority sequencing was introduced, which plays an important role in motivating extrasyllabic and syllabic /s/ in Blackfoot, since /s/ is the only consonant that creates sonority sequencing violations, and because in fact most clusters involving /s/ violate sonority sequencing.

Since the proposal of a moraic /s/ in Blackfoot predicts that it should be able to form a syllable nucleus, Chapter 3 also discussed syllabic /s/ in Blackfoot, and how this hypothesis explains the apparent cases of tautosyllabic geminates seen in words like *iikómsskika'pssiwa*, 'he is hard to take care of'. This parallels Derrick's (2007) claim of a syllabic /s/ in Blackfoot. Such complex consonant clusters do not fit with the fact that most Blackfoot syllables are simple, and positing syllabic /s/ in Blackfoot greatly reduces syllable complexity, making it possible to unambiguously syllabify words that otherwise seem difficult or impossible to syllabify. Ambisyllabicity plays a large role in assessing the status of geminates, since geminate consonants should be ambisyllabic according to Hayes (1989). I introduced the contrast between perceptual and structural ambisyllabicity, the latter being the type assumed by "ambisyllabic" in this thesis. Root-initial alternations between [ss] and [iss] were discussed, which supports the idea of moraic /s/ in Blackfoot, since surface [s] is always in a weight-bearing position. The proposal of syllabic /s/ provides a solution to the problem of syllabifying long strings of consonants in Blackfoot, which otherwise cannot be syllabified by any universal principles. By treating /s/ as syllabic and /ts/ and /ks/ as affricates, principles such as sonority sequencing and Vennemann's (1988) syllable contact law can be obeyed, and universal principles can be used to syllabify Blackfoot words. This is not the only possible way to treat Blackfoot syllable structure,

but this thesis takes the position that positing /s/ as syllabic in Blackfoot is useful and theoretically motivated.

Assuming syllabic /s/, the maximal Blackfoot syllable is sCVVCC, where the first member of a complex coda must be /s/, and several phonotactic constraints operate on complex codas as well (viz., the first member must be /'/ , /h/, or /s/, and the second member must be a stop or affricate). From markedness constraints we would expect CV to be the most common syllable type in Blackfoot, which it indeed is. What markedness constraints do not explain, however, is the overwhelming percentage of CV syllables in Blackfoot: most Blackfoot syllables are CV. This statistic holds true of syllables without geminate /ss/, and holds true of syllables with geminate /ss/ if a syllabic /s/ analysis is used. What I take from this is that the Blackfoot syllable is simple, and that opaque prosodic organization is responsible for the superficial complexity seen in examples such as *isstsskáán*, 'dust'. Syllabic /s/ is marked, just as complex syllable margins are, but while there is evidence to suggest that Blackfoot seeks to avoid complex syllable margins, there is no evidence to suggest that Blackfoot seeks to avoid complex syllable margins involving /s/, meaning that /s/ must be different in some way from other consonants. This thesis has proposes that this different is the attachment to an underlying mora.

Chapter 4 offered an OT analysis of moraic /s/ in Blackfoot, and how extrasyllabicity, moraicity, and syllabicity of /s/ can be represented through OT constraints. I proposed the PROSODICSEQUENCING constraint to account for why moraic /s/ could not participate in complex onsets at the syllabic level, why I believe this constraint is preferable to the usual *ONS-μ constraint, and how this constraint accounts for the extrasyllabicity of word-initial moraic /s/ in Blackfoot. Another constraint introduced was the *NC̥]$_{\sigma}$ constraint, which militates against

nasal + voiceless stop codas. This constraint is relevant in Blackfoot because it supports syllabic /s/, the lack of which would result in a number of complex NC̥ codas.

5.2 Implications

The theoretical claims set forth in this thesis have numerous implications for Blackfoot phonology, Optimality Theory, and linguistic theory in general. Blackfoot syllable structure is understudied, and few authors have attempted any comprehensive system for syllabifying words (Kaneko 1999). By assuming syllabic /s/ in Blackfoot, it becomes possible to syllabify any Blackfoot word by using universal markedness principles. The proposal of moraic /s/ explains why only /s/ can form complex onsets, and why /s/ can act as a syllable nucleus.

I have argued for is the necessity of accounting for markedness gradience in Optimality Theory. While the development of a useful representation indicating the severity of a violation is outside the scope of this thesis, the current practice of simply marking a violation or not is sometimes insufficient, since the severity of a violation can play a role in phonological processes, including those in Blackfoot. In addition, I have proposed two new constraints, PROSODICSEQUENCING and *NC̥]$_{\sigma}$, to account for the behavior of /s/ in Blackfoot. These constraints have implications cross-linguistically. Both are intended to function in every language. While I have based them on cross-linguistic tendencies, it is still necessary to actually apply them to phonological processes in other languages, since they make predictions that can be tested.

Several issues brought up in this thesis have implications for linguistic theory in general, not just for Blackfoot. The proposal of an inherently moraic consonant has interesting implications cross-linguistically, and the claim of moraic /s/ in Blackfoot predicts syllabic /s/.

Most languages with syllabic consonants utilize the most sonorous ones, as in English syllabic sonorants in words like *table*, *button*, or *rhythm*. Blackfoot may be a counterexample to Zec's (1995) claim that any language with syllabic obstruents will have syllabic sonorants.[34] Thus the fact that Blackfoot has no syllabic nasals but does have a syllabic /s/ presents an interesting case study in syllabic consonants. As for moraic /s/, I am unaware of any previous claims regarding underlying moraicity for a consonant phoneme in any language, though all vowels are held to be underlyingly moraic in all languages. This moraicity explains why Blackfoot violates Zec's universal hierarchy. While more research needs to be done, positing an underlying mora for the phoneme /s/ in Blackfoot offers explanation for the unusual distribution of /s/ and /ss/ in Blackfoot.

5.3 Issues for further research

A fruitful area for future research is the status of /'/ and /h/ in Blackfoot. I have proposed that /s/ is inherently moraic in Blackfoot, and Elfner (2006) proposes that /'/ and /h/ are "preferentially moraic". It would be worthwhile to discover if there is a basis for claiming that /'/ and /h/ too are always attached to an underlying mora, and if there is a basis for claiming so, why these phonemes have such a similar distribution to each other but so different from /s/. Another question regarding /h/ is whether it can act as a syllable nucleus, and thus if /s/ is indeed a special case in Blackfoot or if the language allows other syllabic obstruents. The devoicing of vowels before /h/ leaves what Don Frantz (p.c.) has described as a "vowel-flavored back fricative"; thus *ómahk*-, 'big/old' could be transcribed as [ómą̊χk] or [ómχk]. While the latter transcription style was heavily used by Uhlenbeck (1938), I prefer the former since it makes

[34] Another explanation would be to suggest that /s/ is a sonorant in Blackfoot, and is higher on the sonority scale than nasals.

explicit both that the fricative takes on the features of the vowel and that it forms a syllable nucleus, rather than being a member of a complex coda. However, the question remains as to whether, at the phonetic level, the syllable nucleus consists of a devoiced vowel and the fricative, or just the fricative itself. The assertion of syllabic [x] in Blackfoot supports the assertion of syllabic /s/, since any language with syllabic obstruents, e.g., Berber, allows syllabic /s/ (Bell 1978).

Another area of future research is to test the constraints proposed herein in other languages. I have shown that these constraints play a role in Blackfoot phonology, and have explanatory and predictive power. Future research can determine what role these constraints play in the phonology of other languages. A thorough cross-linguistic study of the correlation between syllable types and phonological inventories would also be useful. There appears to be a significant correlation between the size of a language's phonological inventory and the amount of syllable complexity it allows, i.e., the larger the size of a language's phonological inventory, the greater complexity in syllable structure it will allow, and vice versa, but this is a question that can only be answered by data from a large number of languages.[35] If this assumption proves true, this would further support my premise that /s/ clusters in Blackfoot require some explanation, being typologically unusual for a language with a small phonological inventory. It seems to be the case that languages that routinely allow complex syllable margins also tend to have large phonemic inventories. Hawaiian and Japanese, which have relatively small phonemic inventories, have very restricted syllable types, while Coeur d'Alene and Georgian, with large phonemic inventories, allow long strings of consonants. If this tendency proves true over a large sample of languages, this would reinforce the unlikelihood Blackfoot, which has a relatively

[35] This relation seems counterintuitive, since languages with fewer phonemes would need more syllable complexity to avoid overly long words, but it seems to hold, e.g., Coeur d'Alene and Georgian vs. Japanese and Hawai'ian.

small phonemic inventory, having syllable margins as complex as we would see without the assumption of syllabic /s/. It would also be useful to investigate other Algonquian languages to see if similar cases obtain. Some languages seem to exhibit i-deletion in certain environments, e.g., *Anishinaabe* vs. *Anishnaabe*, and it would be useful to determine if any of these cases result in what could be analyzed as a syllabic fricative.

A further theoretical question is how long consonants receive their length. Hayes (1989) proposes that it is due to attachment to an underlying mora, but presents only intervocalic geminates, which raises the question of how to represent non-intervocalic geminates. Moraic Phonology is less studied since the advent of Optimality Theory, yet is not at all superseded by OT. Rather, as I have demonstrated in this thesis, the two theories are complementary, dealing with different levels of phonology. By further studying languages with geminate consonants, especially those that allow them in non-intervocalic environments, it may be possible to settle the question of how long consonants receive their length.

Finally, the question remains of whether the analysis presented here for Blackfoot can be extended to other languages in which /s/ has a special status. Bell (1978) notes that /s/ is the least marked syllabic obstruent, i.e., if a language has syllabic obstruents, it has a syllabic /s/. It may or may not be useful to extend the analysis of moraic /s/ in these languages, especially in any languages that use /s/ but not more sonorant consonants as syllable nuclei. Since positing an underlyingly moraic segment predicts that it should be able to act as a syllable nucleus, it seems less likely that the analysis of moraic /s/ is a useful one in the many languages that use /s/ differently from other phonemes but not as a syllable nucleus. However, since /s/ is exceptional in many languages, future research may shed light on whether there is some universal difference between /s/ and other phonemes cross-linguistically. Earlier I discussed the exceptionality of /s/

in English, wherein only /s/ can occur in triconsonantal onsets. /s/ also seems to have a special status in Cherokee (Iroqouian) and Haida (isolate). In the Cherokee syllabary, all symbols represent a CV syllable except one: the symbol for /s/ (Homes & Smith 1977). This is because only /s/ can occur in underlying coda position or in complex onsets, though other consonants appear in coda position due to i-deletion: *hilv́sgi*, 'several'; *sgigadu(i)*, 'fifteen'; *yan(a)ssí*, 'buffalo'.[36] Haida, too, allows /s/ in positions where other phonemes are disallowed: *sdal*, 'slope'; *sk'waagaa*, 'be high water' (Enrico 1991). Generally, /hl/[37] is also allowed in these positions, suggesting that in Haida this exceptionality is for alveolar fricatives in general: *hldaan*, 'blueberry'; *hlk'waagaa*, 'be a certain-sized object'. On the other hand, complex onsets with /hl/ as the first member do not occur with laterals as the second member, whereas with /s/ they do, which means that /s/ occurs more widely. Enrico (1991) also notes that /s/ and /hl/ can be extrasyllabic in Haida. Whether the moraicity suggested in Chapter 3 is useful for extrasyllabic alveolar fricatives in Haida may be a fruitful area for future research.

5.4. Conclusion

This thesis has described the distribution of /s/ in Blackfoot, and how it differs from other consonants in two ways: (i) only /s/ occurs in complex onsets, and (ii) only geminate /ss/ can occur in non-intervocalic environments. I proposes that these facts can be explained by positing that /s/ in inherently moraic in Blackfoot. This assertion predicts that /s/ should be able to act as a syllable nucleus, and this prediction is supported by the distribution of /s/ in Blackfoot, which more closely matches that of a vowel than a consonant. While more research is needed, the proposal of moraic /s/ in Blackfoot explains why /s/ acts differently than other consonants.

[36] In Cherokee transcription, *v* represents a nasalized schwa, an acute accent indicates stress, *d* and *g* represent voiceless unaspirated stops, and *y* represents the palatal glide.
[37] Haida orthography for a voiceless lateral fricative.

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